ANNALS OF BRITISH GEOLOGY,

1890.

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1890.

A CRITICAL DIGEST OF THE PUBLICATIONS AND ACCOUNT
OF PAPERS READ DURING THE YEAR—
WITH PERSONAL ITEMS.

BY

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LONDON:
DULAU AND CO., 37 SOHO SQUARE.

1891.

LONDON
PRINTED BY GREEN, M'ALLAN AND FEILDEN, LIMITED,
22 ST. ANDREW STREET, E.C.

PREFACE.

THE Book here offered to Students of Geology has been suggested by the "Geological Record." It differs, however, from that work in such fundamental particulars as to occupy a different ground. In the first place, it is not so ambitious as to attempt to deal with the writings of the whole world. Geology is so largely a local science, that much of the work done in it has only a local interest. England has, no doubt, as good a right as any nation to be the universal chronicler; but if others were to take up the work we should have several records, all of which ought to be alike, but probably would not be. We already have the French "Annuaire Universelle." It is hard enough to make the record complete for our own country; it will be inevitably more defective for other countries, and therefore be unequal in execution as a whole. If, however, each country could undertake its own recording, the whole series would be as complete and even in value as the varying capacities of the several recorders might render possible. There is already an annual brought out by M. Nikitin for Russian Geology; and if the French "Annuaire" and the German "Neues Jahrbuch" were confined to their respective nations, a fair beginning would be made, and if the International Geological Congress could charge itself with the general oversight of the whole, and authorise the several recorders, we might then hope for an adequate Geological Record for the world. The present work is, therefore, an attempt to supply a British contribution to this desired undertaking.

The limitation of the Record to our own country renders possible another modification, which is believed to be desir-

able, and which, in fact, alters the whole character of the work. The "Geological Record" is an eminently useful book, but it is very unreadable. Even when, as formerly, it contained abstracts of the writings quoted, they were forced to be so brief that they could only give a bare idea of the contents, which was too meagre to be of any use without reading the papers themselves. The present work, on the contrary, is meant to be readable, and to convey to the reader all the important facts and arguments brought out in the papers, and so to make him acquainted with the actual progress of the science. Another important result is that the production of the volume in something like reasonable time after the close of the year is rendered more feasible.

The other features of the work are possibly more questionable. It is critical. The ideal of a critical work is to be judicial and, therefore, impersonal. It may be thought that as the ideal cannot be attained, criticism should be entirely avoided. It seems to me, however, that even mistaken criticisms are better than the tameness of none, and when they are just they may be of positive value to the student. Moreover, as some selection of the contents of any paper must necessarily be made, it must be left to the recorder's judgment what are of importance and what may be passed by, and this is, in itself, of the nature of criticism. When, too, things which might be expected are not found in the original, this must be indicated, lest it should be thought that they have been omitted by the recorder. When the statements actually made appear to be obviously erroneous or inconsistent, if they are not ignored as they would be in reading, the error and the reason why it is so must be pointed out, in order that either the statement or the record of it may be corrected by the authors, if they will only take the matter in good part.

In this connection it is obvious that in any future volume a great improvement might be made by the co-operation of specialists in the several departments. On this first

occasion, however, circumstances have prevented this. The idea of the work only struck me last February, or about a year too late, as, to be of any use, a work of this kind must appear as soon as possible. It has had, therefore, to be executed with more than convenient dispatch—which must also be the excuse for many minor defects that may be found. It might have been postponed for a year, and the volume for 1891 have been made the first, but one must strike while the iron is hot, and as the "Geological Record" will probably be only brought down in its next volume to 1889, this would have caused a gap, for some time, at least, of the intervening year. Moreover, to present the conception of the book to geologists, a uniformly executed model must be made. This model may be defective, but it shows the idea as no other method would do.

Another feature in this work is its classification—which is entirely by subjects—even down to individual writings. This will necessitate some few cross references, but on the whole seems to be the most instructive method.

It is obvious that the value of any such annual as this depends largely on its continuance. The subjects included in any one year are very much a matter of chance; and it is only when several successive volumes have appeared that students, by looking back through them, can find an adequate record of the general progress of geology. It is hoped, therefore, that the present will be found sufficiently useful to justify the continuance of the undertaking. It ought to be of value to local workers, in bringing their writings to the knowledge of the general body of geologists, and it is hoped that local societies will aid in its execution by communicating their transactions.

Finally, attention may be drawn to the "Personal Items," which it is hoped will have an independent interest.

J. F. BLAKE.

43 Clifton Hill, London, N.W.,
October, 1891.

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NOTICE TO THE READER.

THE Paragraphs contained in square brackets [ ] are by the writer of this work, and do not express the opinions or statements of the authors of the papers or books being dealt with, but are more often criticisms of these. Nor must these authors be held to have used the phraseology employed in giving an account of their works, except when between inverted commas.

As the contents of the papers are sometimes mixed, or have interest from more than one point of view, the following additional references are given:—

For Generalities, *see* **208—210, 212—3, 295—6, 581**; Forces at Present in Action, *see* **63—66**; Glacial Theories, p. 165; Stratigraphical Phenomena, **115, 163**; Physiography, **259, 326**; Cambrian, **117—125, 351**; Permian, **188, 195, 203**; Oolites, **220—1**; Human Implements, **275**; Fossil Mammals, **324**; Palæobotany, **241—2**; Petrology, **188, 195, 203**; Igneous Rocks, **591**; Economics, **152, 166, 170—6, 199, 266**; Foreign Fossil Reptiles, **394**; Foreign Fossil Fishes, **398, 400**; Foreign Gasteropoda, **445**; Foreign Fossil Invertebrates, **460, 466**; Foreign Petrology, **30, 537—8.**

ANNALS OF BRITISH GEOLOGY,

1890.

GENERAL GEOLOGY.

GENERALITIES.

[**1.**] **Müller, H.**—The Crust of the Earth.

Paper read to the Sidcup Literary and Philosophical Society, Nov. 4, but not published in 1890.

[**2.**] **Lucas, A. W.**—The Composition of the Crust of the Earth.

Paper read to the Chester Society of Natural Science and Literature, Nov. 20, but not published in 1890.

[**3.**] **Callaway, C.**—The Evolution of the Earth's Crust.

Paper read to the Birmingham Philosophical Society, Dec. 3, but not published in 1890.

[**4.**] **Love, A. E. H.**—Sir Wm. Thompson's Estimate of the Earth's Rigidity.

Paper read to the Cambridge Philosophical Society, April 28, but not published in 1890.

[**5.**] **Mill, H. R.**—On the Mean Level of the Surface of the Solid Earth.

Paper read to the Royal Society of Edinburgh, June 2, but not published in 1890.

6. Mill, H. R.—The Vertical Relief of the Globe.

Scottish Geographical Mag., p. 182, with map.

He adopts the terms *Lithosphere* for the solid globe, and *Hydrosphere* for the liquid portion, and proceeds to indicate the data for calculating the position of the surface of the lithosphere if it were truly spherical, which he calls the mean sphere level. His conclusion is that it lies 1,400 fathoms below sea level. Its contour divides the surface into two parts equal in area. A map of the two hemispheres accompanies the paper, showing the earth as it would appear if the water were removed, and coloured in tint according to the distance above or below mean sphere level. The area below is "abysmal," and occupies 50 per cent.; that above the

sphere level, and below sea level, is "transitional," and occupies 22 per cent.; that above sea level is "continental," and occupies 28 per cent.

7. Dana, J. D.—On the Origin of the Deep Troughs of the Oceanic Depression: Are any of Volcanic Origin?

"Nature," vol. xlii., p. 357 (from the Am. Journ. of Science).

He concludes that they are not, nor due to any superficially-acting causes, but to comprehensive movements connected with the earth's energies.

8. Blandford, W. T.—The Question of the Permanence of Ocean Basins.

Anniv. Address to Geological Society, Proc. in Q. J. G. S., p. 59.

Four arguments have been adduced in favour of the permanence:—

I. *The Greater Density of Infra-Oceanic Crusts.*—The observations are too few. However, if the ocean floor had been elevated and denuded, the detritus would be evenly distributed. The floor cannot have become thicker on account of the numerous volcanoes.

II. *The Volcanic Origin of Oceanic Islands.*—However, the Falkland Islands and S. Georgia are Palæozoic. New Caledonia, New Zealand, the Auckland and Campbell Islands contain ancient sedimentary rocks, and the Seychelles are of granite and gneiss, as are perhaps the Marquesas, and rocks of this kind have been thrown out of the volcanoes in the Canaries, the Cape Verde and Ascension Islands. Many of these are separated by depths of 1,000 fathoms. Even the volcanoes may be the summits of the highest Continental mountains, which are usually of this character.

III. *Absence of Deep-Sea Deposits in Continental Areas.*—Of the truth of this we cannot yet be sure, and possibly some slates may be deep-sea deposits. Moreover, the deep-sea deposits are very small in amount. In the Solomon Islands and Barbadoes, Radiolarian deposits occur, which indicate a previous depression of 1,000 fathoms [if these deposits can *only* be formed at such depths].

IV. *The Relations between the Distribution of Animals and Land Areas.*—He assumes as an accepted "fact" that similarity in organic structure is proportional to the degree of affinity. [It is probable that, on the discussion of this and its converse, that dissimilarity argues remoteness of affinity, the question may ultimately turn.] On reviewing the different classes, he concludes that mammals, birds, and reptiles are each descended from one terrestrial form, and each new group has diverged from one centre, while freshwater fishes and terrestrial molluscs have had several centres and

several ancestral stocks. The groups which are most easily sub-divided have diverged earlier, while those whose members, as in the Passerine birds, are closely connected are of recent development. Animal regions founded on the latter kind are not likely to coincide with those founded on the former. It is thus found that the distribution of the Chelonia, Lacertilia, Ophidia, Batrachia, Fishes, Molluscs and Plants are all different, the differences being greater as the known origination of the divisions in each group was earlier. The principal point to examine is the evidence for ancient land-connection between certain regions.

1. *New Zealand and Australia.*—These must have been united up to the latter part of the Cretaceous period, on account of their common angiosperms—they are now divided by a sea of more than 1,000 fathoms.

2. *The Solomon Islands.*—The common mammalia, snakes, and batrachians show that these, with New Britain and New Ireland, once formed part of New Guinea, and have never been entirely submerged. The absence of many of these from the neighbouring San Cristoval, shows it is not a case of coming over the sea, this island being as easily reached as the rest, but separated earlier. This seems contrary to the idea of a recent elevation of 1,200 feet—which may, however, be local [if well established].

3. *Africa and Madagascar.*—The common mammals prove the union in Tertiary times, but before the advent of the Ungulates to S. Africa, which, except *Potamochœrus*, are absent in Madagascar, at whose advent, however, they could not have been separated by a greater distance than it could swim —say twenty miles.

4. *Madagascar and India.*—The avifauna of Madagascar is more connected with the Indian than with the Ethiopian. The same is the case with the fruit-eating bats. These may have come by intermediate islands, as Wallace says, without a connected continent. The reptiles and batrachia are more allied to African types than the mammals, &c., but some are Oriental. The freshwater fishes have also a double connection. The Batrachia of the Seychelles are allied to those of India and Africa. The freshwater molluscs are, to a great extent, peculiar, but two types belonging to the *Cyclophoridæ* and *Helicinidæ* so closely connect the Seychelles with India, that there must have been a land connection, for all the currents in the Indian Ocean run from the Seychelles to India, and not *vice versâ*, and the wind currents do not cross the Equator as they would have to do. These types are not found in Africa. Now it has been shown that the Mesozoic type of flora is associated in Australia, Damuda, and S. Africa with an Upper Palæozoic fauna; they must, therefore,

have then been connected by land—the Gondwana land of Suess. They could not be transported across the sea, or the European lycopods would be there too, and they were in Africa at an earlier period. In Cenomanian times the Echinoderms of Nerbudda and Europe were allied, but the Trichinopoly ones were much less so, but more resembled those of Natal, showing there was a land barrier separating a north and south sea. Neumayr has shown that the Belemnites in Madagascar are more tropical, and those in S. Africa more boreal, indicating a separation by land in Neocomian times.

5. *S. Africa and S. America.*—Some freshwater fishes are found only in extreme S. America and S. Australasia. Three out of eleven sub-families of *Characinidæ* are common to the Ethiopian and Neotropical regions. *Lepidosiren* and *Protopterus* are found respectively in America and Africa. The same connection is shown in the *Amphisbænidæ*, and some snakes and apodous batrachia, &c. Two of the *Iguanidæ* are found in America and Madagascar, though not in Africa. They had reached Madagascar before the Palæarctic incursion drove them out of Africa. There are four genera of *Colubridæ* with the same connection; and of the family *Dendrobatidæ*, one genus is Mascarene and one Neotropical. The family of *Ætheiridæ* amongst freshwater shells is similarly divided. Neumayr has shown that the Neocomian fauna of Uitenhage differs from the European, but the Jurassic fauna of S. America does not, indicating a barrier westwards of Africa. He suggests that there may have been an Antarctic connection. This would account for the development and spread of angiosperms in Cretaceous times. The union of the great land masses may then have been in the south instead of the north as at present.

With regard to the evidence of atolls, he cannot believe in the solution theory of lagoons, as some are 40 fathoms deep, and the sea water ought also to have dissolved the foraminifera on which the reefs are supposed to be built [possibly the decaying organisms might have something to do with this]. Moreover, atolls are remarkably grouped; they are away from volcanic areas, and there are independent evidences of submergence in Fiji and elsewhere. On the whole, he inclines to believe that the oceans are permanent in the main, but with very large and important exceptions.

[**9.**] **Kendall, P. F.**—The Doctrine of the Permanence of Continents, and its Bearings upon the Problems of Island Life.

Paper read to the Manchester Microscopical Society on Sept. 4, but not published in 1890.

10. Guppy, H. B.—The Origin of Coral Reefs.

Trans. Victoria Inst., vol. xxiii., p. 57.

After giving an account of the views already enunciated with regard to coral reefs, he suggests, or rather shows, that the barrier reef of Australia owes its position to the coral growing on the border of a submarine ridge, by which means the coral growth is limited by depth on the outside, and by sediment on the inside, and can grow nowhere else. It does not stand on a continuation of the land slope, but the space between has been eroded.

11. Lendenfeld, C. von.—Coral Reefs, Recent and Fossil.

"Nature," vol. xlii., p. 29.

He gives an account of the coralligenous deposits of the Tyrolese Trias, which accords well with the subsidence theory, but not with Murray's. In the Tyrolese reefs there is no sign of a primitive nucleus of rock. There are no such slopes as 45°, which is necessary for reefs to rise as they do. [Not *everywhere*. Tyrol is a *continental* area.] The solution in lagoons requires the opposite process to the formation of the reef, and at the same time [but one is during decay, the other during active growth of the coral]. Lateral growth requires enormous time if the sea bottom slopes much.

12. Wharton, W. J. L., "Nature," vol. xlii., p. 81, asks why, on the theory of subsidence for coral reefs, there is never more than a depth of 60 fathoms in the lagoon with a reef of 30 miles diameter and a depth of 200—300 fathoms outside. On p. 85 he gives an account of Goa Island of the Tonga group, which is of ancient volcanic material in the nucleus, but covered with coralline limestone to 1,030 feet above sea level. On p. 148, **C. von Lendenfeld** replies that they get filled up until within a certain distance of the top of the water [but is not very clear]. **Wharton,** in replying again, quotes Bourgainville reef with an outer slope of 90° to 360 ft., 76° to 780 ft., and 53° to 1,500 ft.; Dart reef, 64° to 1,200 ft.; and Macclesfield Bank, 51° to 4,200 ft.

[**13.**] **Carpenter, W. L.**—The General Doctrine of Oceanic Vertical Circulation.

Paper read to the Institute of Civil and Mechanical Engineers on April 2, but not published in 1890.

UNDERGROUND TEMPERATURE.

14. Everett, L.—Eighteenth Report of the Committee appointed for the purpose of investigating the rate of increase of Underground Temperature downwards in various localities of dry land and under water.

British Association Report for 1889, p. 35.

This gives an account of a boring at Schladebach, near

Dürrenberg, to a depth of 1,748 metres, of which a description has already been given by Herr Dunker in "Neues Jahrbuch für Mineralogie," &c., 1889. Band I.

The arrangement for isolating a part of the water in the bore was as follows:—Two wooden discs were placed over the boring rod, with only just room enough to move. The bottom one is fixed; the upper one is movable, and plastic clay is filled in between them. As the rod presses down it squeezes the clay against the lower one and thus forms a water-tight plug. For bottom temperatures the thermometer is placed below this arrangement, for intermediate ones it is placed between two such arrangements, the lower one being reversed. The thermometer is an overflow one, and the temperature is ascertained by placing it, after use, in water gradually warmed till what is left in it begins to overflow, and this temperature is then read by a standard thermometer in the same water. The temperatures thus observed do not, in this case, differ very widely from those taken in the unprotected bore. It cannot be told in the result whether the curve of temperatures bends upwards or downwards; it is best represented by a straight line, *i.e.*, the rate of increase is constant. By the method of least squares the most probable rate is 1° F. for 65 feet of descent.

15. "Nature," Oct. 23, 1890, mentions a mine at S. André du Pouvier, in France, 3,000 ft. or more deep, with a temperature never exceeding 24° C.

MAGNETIC PHENOMENA.

16. Rücker, A. W., and Thorpe, T. E.—Preliminary Note on Supplementary Magnetic Surveys of Special Districts in the British Isles.

Proc. Roy. Soc., vol. xlvii., p. 443.

There is a centre of attraction S. of Hebrides and W. of Tiree. There is a line of high vertical force which runs from the Wash, parallel to the line of the Wolds, to Brigg. Then it turns west by Butterwick and Howden to Market Weighton, where the magnetism is at a maximum, then along the centre of the Harrogate anticlinal another maximum is reached.

17. Rücker, A. W., and Thorpe, T. E.—On the Relations between the Geological Constitution and the Magnetic State of the British Isles.

Rep. Brit. Ass. for 1889, p. 586.

The magnetic elements, and in particular the declination, have been determined at 200 stations. The increase in the declination going west is not regular, but is enlarged or

decreased by local or regional disturbing forces. These forces are found in different districts to tend towards certain definite points or lines. They may be developed either by the presence of magnetic rocks, or by disturbances in the earth currents of electricity due to the rock constitution. The authors conclude that the former is the true cause, for the following reasons :—1. Rocks which scarcely show any magnetism in the laboratory, have notable effects in large masses, *e.g.*, the Malvern rocks. 2. The localities of the greatest disturbance have been tested for surface earth currents, and little or none have been found. 3. Deeper currents would not be so local. 4. If the disturbance were due to currents, they would have to circle round the points or lines, which is scarcely realisable. 5. The disturbances are certainly marked near known masses of igneous rock, as in the Western Isles of Scotland. In two cases the disturbances are connected, not with visible igneous rocks, but with well-known underground axes. The following are the principal localities where disturbances are indicated :—1. The fault line of the Caledonian Canal. 2. The basalt of the Western Isles of Scotland. 3. The basalt of the coalfield in the South of Scotland. 4. The region in S.E. Yorkshire where the Jurassic strata thin out. 5. The basalt of Mid-Wales and Salop. 6. The line of the Palæozoic ridge in South-East England. 7. The basalt of Antrim, and the igneous rocks at Connemara.

In some cases, as at Kells in Ireland, there are disturbances without ascertainable cause. In such cases they may indicate concealed igneous rocks [or other geological features] which had not before been suspected.

18. Naumann, E.—Terrestrial Magnetism as Modified by the Structure of the Earth's Crust, and Proposals for a Magnetic Survey of the Globe.

Rep. Brit. Ass. for 1889, p. 565.

This has been published *in extenso* in the Geological Magazine for November and December, 1889. He believes the magnetic disturbance to be due to fissures and their contents.

19. Barrett, W. F.—Note on the Magnetic Properties of Columnar Basalt.

Proc. Roy. Dubl. Soc., vol. vi., N.S., pt. 8, p. 382.

The Basalt tested is that from the Giant's Causeway. If the columns are set vertically, the magnetic axis in them is approximately at the angle of magnetic dip. The concave side was a north pole, *i.e.*, repelled a north-seeking pole, and must, therefore, have been downwards [they are for the most part upwards]. The specific gravity being 2·86, the mean magnetic moment was found to be per gramme

0·00186 C.G.S. units. The intensity is, therefore, 0·0054. If the earth were uniformly magnetised, its intensity would be 0·079, or fifteen times as great [giving some notion of the size of the underground masses that deflect the magnet].

FORCES AT PRESENT IN ACTION.—AQUEOUS.

20. Unwin, W. C.—Report of the Committee Appointed to Investigate the Action of Waves and Currents on the Beds and Foreshores of Estuaries by means of Working Models.

Rep. Brit. Ass. for 1889, p. 327.

This work, undertaken by the Mechanical Section, should be of geological interest. The question at present attempted to be answered is, How far a tide running straight up and down an estuary, with vertical lateral boundaries parallel to the direction of the flow of the tide, would leave the bed beach-like with uniform slope, or groove it with low water channels, as in the mouths of estuaries. The main conclusions appear to be:—

1. That the rate of action is proportional to the number of tides.
2. That the first result of the tideway is to arrange the sand in a continuous slope, gradually diminishing from high water to a depth about equal to the tide below low water.
3. That the second action is to groove this beach into banks and low-water channels.
4. That the slope arrived at after 16,000 tides is the same at the high speed in both models, working at corresponding periods, $\sqrt{2}$ to 1.
5. That in both models the steepness of the actual slope increased as the tidal period diminished.

Numerous charts are appended showing the form of the channel assumed, which are very like the charts of actual estuaries, but more exaggerated. If, in fact, the grooves were in proportion, they would be 7—8 feet deep and 80—100 feet distant. [These are called "ripple marks," but being one-fourth the mean rise of the tide, they would not be so in the ordinary sense.] They have their steeper sides looking in the direction of motion, thereby indicating the direction of shifting.

[**21.**] **Reynolds, O.**—Second Report of the Committee to Investigate the Actions of Waves and Currents on the Beds and Foreshores of Estuaries.

Read to the British Association in September, but not published in 1890.

22. Oldham, R. D.—Account of an Experimental

Investigation of the Law that Limits the Action of Flowing Streams.

Abstract in Proc. Geol. Soc., 1890-1, p. 6.

Sandy water was allowed to flow down a trough with an inclination of 1 in 20 on to a semicircular platform, with 1 part of sand to 42 of water ($\frac{1}{42}$) a slope of 1 in 40 [to what?] was formed in the trough; with $\frac{1}{28}$, a slope of 1 in 20; with $\frac{1}{14}$, a slope of 1 in 13·3. These slopes were obtained when a stable condition was arrived at, in which the water was just able to transport its burden. On changing the supply of water, one value of slope is changed for the other. The conclusion is that a river will adapt its channel to such a slope and form as will just enable it to transport the solid burden cast upon it [in other words, the velocity remaining the same, the slope of the bed depends on the amount of detritus carried]. Facts are also stated concerning the fan on the platform, but no definite conclusions appear to be drawn from the results.

23. Wheeler, W. H.—Bars at the Mouths of Tidal Estuaries.

Proc. Inst. Civil Eng., vol. c., p. 116.

He describes the different kinds of bars. Those produced by the alluvium of the river, casual bars thrown up by storms, and shifting bars. He discusses the various theories which ascribe them to (1) the deposition of detritus on the slackening of the water; (2) the form and direction in which the ebb and flood currents meet at the outfall, frequently involving a conflict; (3) the form of the estuary and the insufficiency of back water; (4) the difference of duration of ebb and flood currents. All these are rejected for various reasons, and the theory adopted that they are due to the action of the sea—which tends to close up the rivers—and the bar is the result of the conflict. The chief evidence for this, is the fact that the bars are composed of sand of larger grain than anything the river brings down. Uniform funnel-shaped estuaries are most free from bars.

24. Cole, E. M.—Coast Erosion in Yorkshire.

"Research," vol. ii., p. 225.

In 1786, Polson recorded the distances of certain churches near the coast from the cliff. The distances of the same churches from the present cliff have been recently measured by Capt. Kenney, R.E., of the New Ordnance Survey. A comparison gives the following table:—

	Distance from cliff in 1786.	Ditto in 1889.	Loss in 103 years.	Annual loss.
Hornsea ..	3,399 ft.	2,695 ft.	704 ft.	6 ft. 10 in.
Aldborough	6,132 ft.	5,604 ft.	528 ft.	5 ft. 1½ in.
Tunstall ..	2,772 ft.	2,075 ft.	697 ft.	6 ft. 9 in.
Holmpton ..	3,600 ft.	3,145 ft.	458 ft	4 ft. 5 in.

This shows that the rate of erosion varies from spot to spot. Other evidence shows that it varies at the same place from time to time. Thus at Atwich, in 9 years previous to 1795 the average rate was 10 ft. 4 in. per annum; from that time to 1871 it was only 4 ft. 8 in. per annum.

[**25.**] **Marten, H. F.**—On some Water-worn and Pebble-worn Stones taken from the Apron of the Severn Commissioners' Weir, erected across the river at Holt Fleet, about Eight miles above Worcester.

Paper read to the Geological Society on Dec. 10, but not published in 1890. Abstract sent to Fellows.

26. Corpi, F. M.—The Catastrophe of Kantzorik, Armenia.

Q. J. G. S., vol. xlvi., p. 32.

This catastrophe occurred in the district of Tortoum, about 60 kilometres from Erzeroum, in a narrow valley, at a height of about 1,600 metres. It consisted of a huge stream of mud which flowed down the valley from the Eastern Mountain and overwhelmed the village of Kantzorik for a distance of 7 or 8 kilometres and a breadth of 100 to 300 metres. The mass, after coming to rest, had the appearance of an undulating sheet with an irregular surface, and large balls of the mud were carried further down the valley. This ended, in the east, in a great crevasse which was produced by the sinking in of the western flank of the mountain. The whole was probably a gigantic landslip of the secondary rocks over some slippery portion of them.

[**27.**] **La Touche, T. D.**—On the Sounds known as the "Barisal Guns," occurring in the Gangetic Delta.

Paper read to the British Association on Sept. 4, but not published in 1890.

FORCES AT PRESENT IN ACTION.—HYPOGENE.

28. Browne, R. Mackay.—As to certain Changes of Level along the Shores of the Western Side of Italy.

Abstract in Proc. Geol. Soc., p. 122.

He thinks the change of level round the Bay of Baiæ is general all round the Mediterranean [but gives no facts to prove it], and suggests that the former rise of water may be due to the Atlantic having stood at a higher level relatively to the Mediterranean than it does at present, so that an inflow was caused; this elevation being due to "changed combinations of astronomical forces." [These speculations do not appear to rest on anything in particular.]

[**29.**] **Browne, R. G. M.**—As to certain Alterations in the Surface Level of the Sea oft the South Coast of England.

Paper read to the British Association on Sept. 10, but not published in 1890.

VOLCANIC PHENOMENA.

30. Dana, J. D.—Characteristics of Volcanoes. London, 8vo, pp. 399. Plates.

The essence of this book is the study of volcanic phenomena in relation to the Hawaiian volcanoes. Only the most salient points can be noticed. He recognises the two kinds of lava there, the ropy and scoriaceous; the latter, called "a a," have "lava-balls" (the so-called bombs). The little jets, with almost vertical sides, he calls "driblet" cones. The Hawaiian volcanoes are on a *line* of eruption; they were originally 15 in number, only 3 now being left in action. On the east, the neighbouring sea is 2,000—3,000 fathoms deep. The craters are "pit craters," with vertical walls. There was in 1840 a lower ledge in Kilauea—now filled up. The lava quietly wells up and does no harm, unless it runs your way, in which case you step aside. Pele's hair is made by little lava jets, darting some 10 or 12 yards up, in which the clots are drawn out *in the ascent* and the hairs spun as the pieces pull apart. They are then laid to leeward by the wind like mown grass. A complete history is given of the eruptions and changes in the crater of Kilauea from 1823 to 1887. There has been a deep hollow of small dimensions in the centre of the flat crater surface, called Halemauman, with a steaming *débris* cone in the centre, like one of fallen walls of lava. This has gradually ascended bodily in relation to the walls of the cavity; the lava lake lying between in one part. The lava flooding of 1885 left the bottom covered with smooth ropy lava. (Pl. VII., photographed.) In some parts it bulges up into domes with cracked surfaces. Flames from one to three feet in height, pale greenish in colour, were seen in 1887 by three or more simultaneous observers within the area of the lake, where heavings and breakings of the lava crust took place. From this history it is concluded—(1) there is no well marked periodicity in the eruptions; (2) the rise of the floor after several eruptions was at the annual rate of 93, 71, and 72 feet; (3) the large floor has always been at a higher level after each eruption, till, in 1886, the whole of the inner or "Black" ledge was covered; (4) between 1886 and 1889, Halemauman changed from a cavity with a deeper crater within, to a level with a cone rising from the surface; it has, however, gone down again a little. The cycle of operations is a rise of the lava level, a discharge down some conduit, and the down plunge of the undermined floor.

Kilauea is a basalt volcano, kept in perfect fluidity (not viscosity) at a temperature of about 2,000—2,500° F. The conditions of fluidity are not dependent on basicity, but on fusibility; anorthite, *e.g.*, being very infusible, as is chrysolite,

Cinder cones can only form when the heat is low, and there is here very little ash. The lava flows unbroken down vertical precipices. From community of operations at eruptions, he infers that the liquid reservoir is as large as the great crater. Besides ordinary scoriæ in the lava, there are "spongy thread-lace scoriæ," in which the vapour is 98 per cent. of the whole; the very liquid glass forming merely linear polygonal threads, like a soap-froth. These occur as a layer on the surface. He calculates that, at ordinary pressure, ·0001 per cent. of water is sufficient as steam to produce 40 per cent. of vesicular space, and for this soap-froth only 1·1 per cent. is required. The outburst is due to the imbibition of moisture under pressure and the subsequent union of the particles into vesicles, &c., thus producing expansion.

He next deals with Mauna Loa. The history is given of the visits made since 1832. After the eruption of 1880, lasting nine months, the crater was so cool in 1883 that snow lay in the bottom of the crater—which was surveyed in 1885. Yet there was another outburst in January, 1887, with fountains rising from the lava streams to a height of 200 feet, but these eruptions have always taken place at points below the summit. There is no evidence of periodicity either in the greater eruptions or in the periods of minor activity; 15 out of 19 have taken place in the wetter season. Within the crater are old jets up to 900 feet high. He argues that since it would be more difficult to raise lava to Mauna Loa than to Kilauea, if the vapour came from below—and yet the amount of action of the former is greatest—the source must be the inland precipitation.

He then discusses the general features of volcanic eruptions as thus illustrated. All the known eruptions of these volcanoes are of the non-explosive type. At Mauna Loa the outflows have been always (with doubtful exceptions) below the summit, mostly from the ends of the long diameter, and next from the end of the short diameter of the elliptical crater. The lava gradually rises in the conduit, aided by the expansive force of vapours, and the eruption comes about by fissuring of the lava conduit, in a perfectly quiet manner, only two having been accompanied by earthquakes (1868 and 1884). On the occasion of an eruption the light gets stronger, then clouds rise, then the summit light disappears and the outflow commences at a lower level. The earthquakes occurred far away from the summit, and after the disappearance of the light. They came, therefore, too late to be the cause of the eruption, but they assisted it when occurring by breaking the conduit that held the lava. They originated in the volcano itself. Yet the greatest of the

eruptions had no such aid. The cause is considered to be the access of water to the surrounding heated rocks, not to the lava itself, since there is no explosion. [Possibly the temperature level of the rocks *rises* into contact with water as the column gets higher.]

Hydrostatic pressure has comparatively little effect. The Kilauea eruption, in 1868, was not due to its own condition, but the mountain was broken by the earthquake accompanying the eruption of Mauna Loa. So far from any lava coming out of the crater, lava has been known, in 1880, to cascade *into* the crater from the sides in the early stages.

The difference in the kinds of lava, viz., "pahoehoe" and "aa," appears to be due to the nature of the ground flowed over, the "aa" being cooled into blocks by passing over moist ground.

There is evidence of Kilauea having had an explosive eruption in 1789, by the ejected blocks round the crater.

He formerly thought Kilauea was dependent on Mauna Loa, but now agrees that the former belongs to the Kea range and the latter to the Loa, which are on slightly diverging lines.

The smaller Hawaiian volcanic islands are then described. The Petrography is by **E. S. Dana.** Some of the clinkstone-like basalts have feathery forms of augite, which draw the felspar laths into the group. The chrysolite in the chrysolitic basalt is often elongated into narrow rods, the shorter dimension corresponding to the macrodiagonal of the typical form. In the glassy forms are seen felspar microliths surrounded by dark shreds, also crystallites of four-rayed or six-rayed stars.

In the lava tunnels hang numerous non-tapering narrow stalactites of lava, dropping to stalagmites. They are coiled like small intestines. The surface is minutely fimbriated; the interior sometimes contains cavities, but the substance is crystalline throughout and contains no glass. The cavities also are lined with scales of felspar. The lavas of Kilauea are similar in general character, showing very little glass.

The author now examines the question whether the deep troughs near Hawaii are due to the volcanic islands. Similar troughs occur near the Tonga and Kurile islands, but he finds that there are volcanoes without troughs and troughs without volcanoes, and, therefore, decides against the theory. This last chapter appears in "Nature" for August 7th, 1890.

31. Johnston-Lavis, H. J.—Report of the Committee appointed for the Investigation of the Volcanic Phenomena of Vesuvius and its Neighbourhood.

Report Brit. Ass., for 1889, p. 283.

This continues the account of the action of Vesuvius from

June, 1888. From that date to January, 1889, the activity was variable. On January 1st, an opening was made in the side of the cone, and on January 6th an eruption of lava occurred when Dr. Lavis was in the crater. "My porters," he says, "abandoned me, and I proceeded to take two instantaneous views." The lava spread rapidly, and divided into three tongues over the crater plain. On January 19th lava again burst forth and moved a slice of the cone of eruption forwards and outwards. The cone commenced to mend by eruption on the 27th, and continued till the middle of February, when lava commenced to flow, and then the cone began to be built up again till April 24th. On May 2nd the dyke that had been forming reached suddenly one-third down the great cone, and lava flowed as far as the Atrio del Cavallo, where it divided into two streams, the sides of the cone at the same time falling in from want of support. This reft is probably in connection with, as it is close to, the fissure which gave rise to the 1881-2 eruption. On the last day of May the crater, within the cone, was about 40 m. deep, and from thence to August lava continued to flow. On the 25th, there was greater activity within the crater, whose bottom had been raised into a rough plain, with a vent near the margin. Five figures illustrate the summit appearances at the different dates.

The tunnels in the Phlegræan fields have been continued, the temperature of the rock reaching 93° C. A number of Roman cuniculi have been crossed which are filled with mineral water on reaching the drainage level, proving subsidence since Roman times. One of these cuniculi branches into three; the lower ones have the walls covered with incrustations of hyaline and crystalline quartz and gypsum, the upper one with thicker incrustations of carbonates of potash and soda. The temperature here was 73°, and Dr. Lavis became almost insensible from the abundance of carbonic acid. The temperature must have certainly increased since the cuniculus was made. The material is a fine porous tuff. The second tunnel was cooler, and also cut through cuniculi. The water in the bottom was at 67° C., and the stones were covered by a dark slime of hydrated peroxide of manganese, with gelatinous silica in patches. The funicular tunnel at Monte Santo, Naples, shows the tuff of the district overlying vegetable soil, proving its subaerial origin in spite of the few marine shells—which may be ejected blocks of accidental origin [assuming there have been no changes of level ?]; below the vegetable soil and some pumice beds comes a coarse breccia of various rocks, in one of which Dr. Lavis found some rhombic dodecahedra, resembling Hauyne, below this grey pipernoid tuff, and then

some pumice beds at the base. With regard to the grey pipernoid tuffs of the Campania—so like these last—he concludes they were not erupted volcanic muds, for which he can find no orifices, but they fell as ash, and have been converted into mud by the rain from the mountain.

[**32.**] **Johnston-Lavis, H. J.**—Report of the Volcanic Phenomena of Vesuvius and its Neighbourhood.

Read to the British Association in September, but not published in 1890.

33. Johnston-Lavis, H. J.—The State of the Active Silician Volcanoes in September, 1889.

Scottish Geographical Mag., p. 145.

Gives a brief account of the visit of the Geologists' Association excursion to Stromboli and Vulcano. Notes the long talus (Sciarra) of Stromboli, and the bombs of Vulcano. In March, 1890, damage was done to the telegraphic cable near Lipari, and the depth of the sea was found reduced to 82 metres [from what is not stated]. This he thinks due to a submarine, non-explosive, eruption. The crater of Etna was found to have enlarged, the walls to be nearly perpendicular, and the bottom flat; about 100—200 metres below the crater edge numerous fumaroles cover the bottom.

34. Johnston-Lavis, H. J.—The Eruption of Vulcano Island.

"Nature," vol. xlii., p. 78.

Some general matters of recent observation. His "bread crust bombs" he regards as signs of acidity, and states that at Rocce Rosse "a large mass of obsidian was hurled up and fell on the crater edge at Monte Pilato. In consequence of the sudden shock on reaching the ground, the semi-plastic mass cracked, and each fragment, relieved from the surrounding pressure [due to the cohesion of the mass?] expanded into a small bread crust bomb" [are there a collection of bombs in a heap?].

35. Fulcher, L. W.—Vulcano and Stromboli.

Geol. Mag., Dec. 3, vol. vii., p. 347.

This gives a history of the eruptions of Vulcano up to date. Noting that Prof. Silvester (C. R. 109, p. 241) has proposed to call this state of a volcano "Vulcanian," intermediate between Plinian and Strombolian. An inclusion in one of the "bombs," which is white, like quartz, the author has found to be glass, with felspar fragments, fading away at the edges, he hence regards it as a fused granite. He then gives a similar account of Stromboli, and of his own visit with the Geologists' Association in 1889.

[**36.**] **Fulcher, L. W.**—Vulcano and Stromboli.

Paper read to the London Amateur Scientific Society on May 23, but not published in 1890.

[**37.**] **Thomas, T. H.**—A Visit to the Volcanic Districts of S. Italy and the Liparis.

Trans. Cardiff Naturalists' Soc. vol. xxii., pt i. ? 1890.

Not seen.

[**38.**] **Anderson, J., and Johnston-Lavis, H. J.** —The Supposed Volcanic Eruption of Cape Reykjanaes.

Paper read to the British Association on September 5, but not published in 1890.

39. Johnston-Lavis, H. J.—Excursion to the South Italian Volcanoes.

Proc. Geologists' Association, vol. xi., p. 389.

This is mainly occupied with the doings of the party, but there are a few critical observations, as on the pumice of the Campi Bianchi. This, he thinks, was formed by the material in the pipe being entirely fused and glassy, and containing absorbed water, which, accumulating force, finally broke out, when the water, on relief of the pressure, turned to vapour. The pure obsidian is what remains, with less water. His idea of the origin of Vulcano is not that of a shifting focus, but of two great cones, one at either end; one of these is trachytic, the other doleritic, and they may have been contemporaneous. Later explosions truncated first the doleritic, then the trachytic cone, and the south crater has been filled up, and made a plateau by eruptions from the north one, which has developed a new cone from its base. The "Piperno," of the Pianura is on the same horizon of the Pipernoid tuff of Naples, but the former is not an altered tuff, but a lava, the pipernoid structure being produced by the pasty magma, which was composed of two portions in different states, issuing from a narrow vent [but the language is obscure].

40. Milne, J.—Ninth Report of the Committee appointed for the purpose of Investigating the Earthquake and Volcanic Phenomena of Japan.

Rep. Brit. Ass. for 1889, p. 295.

The Grey-Milne seismograph has recorded 79 earthquake shocks at Tokio between June, 1888, and March 1889, the most violent of which was on Feb. 19, 1889. The motion was greatest on the soft low ground, nevertheless the smaller earthquakes are more often felt upon high ground which is less covered by alluvial soil. Eleven of these felt earthquakes were unrecorded by the seismograph, being too local.

On July 15, 1888, a great volcanic eruption took place at Bandaisan, which had been dormant since A.D. 807, and whose volcanic form had been lost. Two or three slight earthquakes were felt previous to the eruption, and the springs diminished. There was then a terrific explosion, followed by 20 more. It blew out a crater 1½ square miles in area, and removed 1,587 million cubic yards of material. Some of

this consisted of masses of rock 30 feet in diameter, and it moved at the rate of 48 miles an hour. At a distance of 7 miles from the eruption, 97 inhabitants of Nagasaka were overwhelmed by the rock and boulders before they could run 500 yards. The material now covers 27 square miles of country in a fan-shaped form. After the downpour of the *débris*, cauldron-like mud holes in the crater threw up greyish gritty mud, which was carried by the wind for 62 miles, and covered 1,000 square miles. The eruption was accompanied by a terrible hurricane, and afterwards were found thousands of holes 20—30 feet in diameter, and 10 feet in depth. These are supposed to be produced by the squeezing by the earthquake of watery strata which burst at the points of least resistance. The Report concludes by recommendations of the forms of houses best suited to resist earthquakes, which should be built on solid ground, and either so rigid as to be like a steel box, or so flexible as to be like a wicker basket.

[**41.**] **Milne, John.**—Tenth Report of the Committee for Investigating the Earthquake and Volcanic Phenomena of Japan.

Read to the British Association in September, but not published in 1890.

42. Smith, C. M.—The Volcanic Eruption at Bandaisan.

Proc. Roy. Soc. Edin., vol. xvii., p. 65.

This was entirely due to an explosion of steam, which broke the mountain Kobandai to pieces, and carried material in a semi-dry flood of mud to the north—rushing up opposing hills 150 ft. above the general level, passing over a col. 200 ft. high, and suddenly, by internal friction, stopping with a nearly vertical front. Since the explosion, in ten months, the little stream of Biwasawa has eroded a valley, 80 ft. wide by 80 ft. deep, as measured, and one 150 ft. deep, as estimated. This is illustrated by a photographic plate. Large blocks in the mass sometimes make waterfalls, and thus varying slopes. The mud is now beginning to consolidate. The rocks thrown out are corroded by acid vapours, and lose their coherency. The author suggests that the dykes which have for ten centuries kept the mountain together, may have thus been disintegrated at last, and, giving way, have allowed the explosion.

43. Smith, C. Michel.—The Bandaisan Eruption, Japan, July, 1888.

Rep. Brit. Ass. for 1889, p. 564.

In the abstract given, no further information appears than has been already noted above and in the report by Prof. Milne, except that, as shown by photographs, the earth

torrent flowed over obstacles as large as a hill 200 ft. in height, and the density of the stone-storm is shown by 75 marks being counted on a six square inches of a tree trunk.

44. Atkinson, R. W.—A Japanese Island Volcano.

Cardiff Nat. Soc. Rep. and Trans., vol. xxi. (p. 2.), p. 51.

He ascended the volcano Mihasayama, in the island of Vries, in 1877, when it was in eruption. Its sides are hollowed into deep paths by the bullocks carrying down wood. The crater is about 1,000 yards by 300 yards, and 200 yards deep, the new crater being formed in its midst, by explosions of lava lumps. From one side they could see the boiling, heaving liquid in the cauldron, covered with cloud and smoke—but on eruption it was thrown up 1,000 ft.

45. Lister, J. J.—A Visit to the Newly Emerged Falcon Island, Tonga Group, S. Pacific.

Journ. R. Geograph. Soc., p. 187.

This island was thrown up by a volcanic eruption in 1885. The focus at that time was entirely on one side, the S.E. trades driving the ejected material to leeward. The cone is about three-fourths gone, only a fragment being left, beyond which is a long flat of about twice the area. Volcanic bombs are scattered over the slope of the hill, one variety is of "whitish grey stone, with white crystals" [trachyte?], the other, "a coarse conglomerate" [amygdaloid?]. The material is "fine-grained greenish-grey" [trachyte tuff?]. The interior is still hotter than the air. Landslips are incessant, and in a few years the island will have disappeared below the water, and form the basis for coral growth. Three photographs of it are given.

THEORIES OF VOLCANOES.

[**46.**] **Darm, J. W.**—Volcanoes.

Paper read to the Birmingham Microscopists and Naturalists' Union, Feb. 24, but not published in 1890.

[**47.**] **Hart, Thos.**—Notes on Volcanic Eruptions.

Paper read to British Association on Sept. 10, but not published in 1890.

48. Johnston-Lavis, H. J.—The Extension of the Mellard Reade and C. Davison Theory of Secular Straining of the Earth to the Explanation of the Deep Phenomena of Volcanic Action.

Geol. Mag., Dec. 3, vol. vii., p. 246.

[So far as this paper can be understood, it attempts to show—by means of the theory alluded to—how a fluid mass can be accumulated below a volcano. This theory he appears to misunderstand. He says the "tendency of all

the shells beneath the no-strain zone is not only to crumple all above it, but to compress the uncooling nucleus." The theory, on the contrary, is that below the "level of no strain" there is no crumpling, but an increasing tension. He then speaks of the compression reaching its maximum limit, and equilibrium being restored by fracture. He says the fracture "would tend to be fusiform in section (I am open to correction)," but he does not say how this could be managed —whether in isolated spots or long streaks—and into these fusiform cracks the molten material below would be squeezed, and its upper end would lead to a volcano. This is not in the least like anything that could be gathered from the views of Mr. Mellard Reade, even if his hypothesis itself were well founded—and is obviously due to some misunderstanding of the matter.]

49. Reade, J. M.—Secular Straining of the Earth in Relation to the Deep Phenomenon of Volcanic Action.

Geol. Mag., Dec. 3, vol. vii., p. 344.

This is drawn out by Dr. Johnston-Lavis's letter, which the writer pronounces "ingenious and suggestive," but does not otherwise deal with, except seeking a central source for volcanic eruptions. He points out the many difficulties before we can arrive at any satisfactory conclusion on the effect of the contracting shell on the earth's nucleus—but thinks it may have some effect—though fissures would be prevented by "compressive extension."

50. Beasley, H. C.—What Becomes of the Water Ejected from Volcanoes?

Proc. Liverpool Geol. Soc., pt. 2, vol. vi., p. 198.

He suggests that the ash and dust, which may itself be produced by the explosive action of the steam as the pressure on it is lessened, may form a porous, spongy stratum, adequate to retain in itself all the water that is ejected from volcanoes—which will not, therefore, even if derived from the interior of the earth, go to swell the ocean. [But will the ash always remain in this loose, spongy state?]

EARTHQUAKE PHENOMENA.

51. Tyndall, W. H.—Earthquakes.

Holmesdale Nat. Hist. Club for 1888-9, p. 60.

A general paper.

52. Davison, C.—On the Study of Earthquakes in Great Britain.

Proc. Birm. Phil. Soc., vol. vii., pt. 1, p. 68, and "Nature," vol. xlii., p. 346.

The smallness of our shocks render them easy to study. The easiest method of observation is by time, by means of a

seismoscope—one of which he describes and figures. It consists of a jutting wire from the bob of a pendulum over which a toothed bar is lightly supported—at one end by a hinge, at the other by resting on a very easily displaced wire. When the latter is moved, the toothed bar comes down and stops the pendulum by catching on the projecting wire. He also gives a list of questions from Heim and Milne to be answered by observers, and the scale of terms of intensity proposed by Rossi and Forel. The object is to ascertain the epicentrum, and, if possible, the seismic focus. He gives a list of eleven papers on British earthquakes, and eleven on general seismology.

ORGANIC AGENCIES.

53. Murray, John, and Irvine, Robert.—On Coral Reefs and other Carbonate of Lime Formations in Modern Seas.

Proc. Roy. Soc. Edin., vol. xvii., p. 79.

Corals and other calcareous-housed organisms are most abundant where warm water is thickest on the ocean surface. This is assumed to be because they can there secrete the material most easily. As to the solution, as the depth increases, it is the delicate shells which disappear first, though very abundant nearer the surface, and only the thickest are left at the extreme depths. The amount of carbonate of lime actully found on an average in the deposits, at successive depths of 500 fathoms, is, per cent., 86·04, 66·86, 70·87, 69·55, 46·73, 17·36, 0·88, 0·00, trace. The authors have conducted experiments to show the source of carbonate of lime as produced by organisms. I. Hens were supplied with distilled water only till they could lay no shells to their eggs; after this, when sulphate, silicate, nitrate, phosphate, or carbonate was added, the eggs were again coated with the usual carbonate. II. Crabs were kept alive in sea water, from which the carbonate was excluded, yet they made their usual coverings out of the other lime salts present. III. The eftete matter of the crabs was found, after a time, to render the water alkaline from the formation of carbonate of ammonia, and ultimately carbonate of lime. IV. Urine was added to sea water, and ammonia was formed; at the end of 7 and 17 days, precipitates of the following compositions were thrown down:—

	7 Days.	17 Days.
Water and organic matter ..	31·81	20·25
Carbonate of lime	4·85	75·35
Phosphate of magnesia and ammonia	51·10	3·38 (without ammonia)
Phosphate of lime	12·23	—
Carbonate of magnesia	—	1·02

V. Urine and sulphate of lime, as in sea water, yielded after 12 days a precipitate containing 51 per cent. carbonate of lime. Sea water from amongst coral atolls they find to contain twice as much ammoniacal salts as that from the Atlantics, and three times as much as that from the German Ocean. This change to ammoniacal salts only takes place in warm water. Hence, in tropical seas, not only do the effete matters there produced decompose, but those produced elsewhere only decompose on reaching the tropics, and hence the abundant carbonate of lime produced from the sulphate. Magnesia is not liable to the same reactions. The authors then state that organic substances become oxidised in the presence of earthy sulphates at the expense of the oxygen of the salts, producing carbonic acid and sulphuretted hydrogen, which is oxidised to sulphuric acid, and thus they say sulphate of lime is produced. In the illustrative equation, the sulphuric acid is shown as obtained solely from the magnesian sulphate, with the precipitation of magnesian carbonate [but it is plain that the *calcium* present is not increased, and if organic decomposition makes it combine with carbonic acid, instead of the sulphuric acid of the sulphate, the latter is decreased, and cannot be absolutely increased also by any other form of decay]. Their experiments show that there is more solution of calcareous matter in summer than in winter, and of recently formed organic structures than of old and crystalline ones. The solution also increases with the pressure. Applying this to the solution of organisms at great depths, they show that the difference will be increased by the undissolved shells preventing access—*i.e.*, the rate of deposit is greater than the rate of solution of the shells. As to lagoons, the decay of the organisms supplies the carbonic acid, and the motion of the water renews it. From the amount of calcium in sea water, the volume of the ocean, the amount of calcium in average river water, and the amount of river drainage, they calculate that to produce 22 feet of the calcareous deposits [over their present area?] would take 680,000 years, provided that the sea has retained the same salinity throughout. Seventeen tables are given illustrative of the above.

54. Irvine, R., and Woodhead, G. S.—On the Secretion of Carbonate of Lime by Animals.

Rep. Brit. Ass. for 1889, p. 637.

Hens supplied with any salt of lime produce normal egg shells, composed of carbonate of lime; but they cannot make shells from magnesium or strontium carbonates. Crustacea cannot assimilate sulphate of lime from the sea water to form their exo-skeletons, but they can produce them from calcium chloride. Carbonate of lime may be formed in sea-water as follows: The carbonate of ammonia produced by

the decomposition of the effete products of animals decomposes a portion of the sulphate of lime with the formation of carbonate of lime equivalent in amount to the carbonate of ammonia.

55. Anderson, W. S.—On the Solubility of Carbonate of Lime in Fresh and Sea Water.

Rep. Brit. Ass. for 1889, p. 637.

Crystallised carbonate of lime is more soluble in pure than in salt water; amorphous carbonate is more soluble in sea water. When sea water stood over crystallised carbonate of lime for a lengthened period it first dissolved and then re-precipitated it. The soluble action of sea water is independent of any carbonic acid in it, for as much was dissolved in artificial sea water free from carbonic acid.

[**56.**] **Fletcher, G.**—Deep-Sea Rock-Forming Organisms.

Paper read to the Derbyshire Archæological and Natural History Society, Sept. 9, but not published in 1890.

[**57.**] **Waller, J. H.**—The Story of a Pebble.

[**58.**] ——————Sands and Clays.

Papers read to the Birmingham Microscopists and Naturalists' Association on March 10 and Oct. 21, but not published in 1890.

59. Aitken, J.—On the Number of Dust Particles in the Atmosphere of Certain Places in Great Britain and on the Continent, &c.

Proc. Roy. Soc. Edinb., vol. xvii., p. 193.

The results of this paper are somewhat interesting geologically. He concludes that the want of transparency of the air depends on the number of dust particles in it and on the humidity in their presence. Humidity alone has no effect, the particles condense the vapour on their surface even when the air is not saturated, the amount increasing with the vapour tension. Haze is usually produced by dust. In country places fall of wind is accompanied by increase of dust. [These facts explain the distribution of moisture, germs, and inorganic particles.]

STRATIGRAPHICAL PHENOMENA.

60. Goodchild, J. G.—Notes on Faults.

Trans. Edinb. Geol. Soc., vol. vi., p. 71.

Faults are produced during upheaval by the unequal yielding of rocks before tangential thrusts—one part going up into an anticlinal, the other going down into a synclinal, and forming a fault with the greatest throw in the centre. A fault once formed, unless cemented up by vein substance,

guides the direction of every subsequent fault. A newer movement along the same fault in an opposite direction may seem to dislocate the upper strata most [but the fault would then appear like a step at the junction]. Small faults may arise from the rocks giving way along joints during upheaval. A newer fault which comes up to another, is deflected along it over the obtuse angle, and then diverges again on the opposite side of the old fault is said to be "trailed." This he distinguishes from "heaving," or the faulting of a fault. In the former case, the broken fault is the newer, in the latter it is the older. This will account for the changes which take place in the broken faults on crossing the unbroken one, for if the latter is the older the broken parts have never formed parts of the same system. In the North of England, judged by this method, the faults running magnetic north are the oldest; next are the N.W. faults, then the S.S.W., and finally those running magnetic east. The filling of particular sets of faults with minerals which do not occur in the rest he accounts for by their being formed during upheaval, when only one set would be stretched open, and the rest would be squeezed close. [Reversed faults were also dealt with, but the abstract is too brief to be intelligible. It seems to refer them to downward pressure, which cannot be their *direct* cause.]

[**61.**] **Burns, D.**—The Bending of Beds near Faults and Veins.

Paper read to the North of England Institute of Mining and Mechanical Engineers on Dec. 13, but not published in 1890.

62. Ricketts, C.—On a Probable Cause of Contortions in Strata.

Journal Liverpool Geol. Assoc., vol. ix., p. 17.

His suggestion is that "flexures may be dependent on irregular pressure caused by the local distribution of larger and heavier particles on accumulations of unconsolidated muddy deposits."

DISINTEGRATING AND ERODING AGENCIES.

63. Goodchild, J. G.—Notes on some Observed Rates of Weathering of Limestones.

Geol. Mag., Dec. 3, vol. vii., p. 463.

The weathering takes place along planes. These may be either the bedding plane, the plane of "bate"—that is a set of obscure planes of easier dressing parallel to the jointing—or the surface plane. As a rule, pure bituminous limestones weather least, impure argillaceous ones most. The absolute

rates observed along one plane only, by means of the amount to which included fossils stand out on the surface after a known length of exposure is $\frac{1}{500}$ in. per annum in Kirby Stephen tombstones; $\frac{1}{250}$ in. in some macadam in an unused road; $\frac{1}{300}$ in. in a glacially smoothed mound at Penrith; $\frac{1}{240}$ in. in the surface of a dressed block at Askrigg station.

64. Wilson, O. C.—On some Decomposed Flints from Southbourne-on-Sea.

"Nature," vol. xlii., p. 7.

These lie under some flinty brown loam, and upon some pure quartzose sand. They are corroded, or entirely decomposed into a soft white powder. When they are banded light and dark, the light part corrodes first, and separates the layers of dark flint. The decomposition must have taken place before the deposition of the loam, as the flints of the latter are not corroded. He suggests that the silica has been attacked by organic acids, produced by decomposing seaweed which lay on the pebbles.

65. Watts, W.—Nitrogen Gas in Strinesdale Tunnel.

Trans. Manch. Geol. Soc., vol. xx., p. 608.

This tunnel is in beds below the coal measures, and from fissures has escaped a gas in quantities sufficient to extinguish light. It is a gas whose composition is nitrogen 92 vols., oxygen 8 vols.; carbonic acid a trace. It is suggested that the air enclosed in such a fissure may have oxidised some coal, and that this is the residual gas, the carbonic acid having been absorbed by the water.

66. Monckton, H. W.—On an Instance of Recent Erosion near Stirling.

Proc. Geol. Assoc., vol. xi., p. 450.

A pond belonging to the Howietown Fishery near Stirling had an overflow channel cut in 1874, which passes over Boulder clay, and ended by a waterfall. Since that time it has destroyed the waterfall and enlarged its channel, but all this work was done in the first few years, and little has been done since. This shows that the erosive power of water depends on the surrounding circumstances. On the strength of this he takes exception to the estimates of time required to denude a surface such as that usually given for the Mississippi, since we cannot tell the conditions it formerly worked under, except that we may be certain that they have differed from the present, and in particular in England the rate immediately after the cessation of glacial conditions would be much more rapid than it can be now. Hence its present rate can be no guide for a calculation of the time that has since elapsed.

GLACIAL PHENOMENA.

[**67.**] **Field, J.**—On Glaciers.

Paper read to the East Kent Natural History Society on Oct. 13.

[**68.**] **Linkowitsch, J.**—Glaciers.

Paper read to the Leeds Geologists' Association, April 17, but not published in 1890.

[**69.**] **Ogden, J.**—The History of a Glacier.

Paper read to the Rochdale Literary and Scientific Society, but not published in 1890.

[**70.**] **Dickson, E.**—Notes on the Moraines and Glacier Streams in the Valley of the Rhone and near Grindelwald.

Paper read to the Liverpool Geological Society, Dec. 9, but not published in 1890.

71. Cumming, L.—Notes on Glacial Moraines.

Proc. Liverpool Geol. Soc., part 2, vol. vi., p. 174.

The observations recorded are for the most part on well-known points. He has observed that some moraines do not stand out on the surface, but lie in depressions, due, he suggests, to the radiation from the moraine melting the neighbouring ice. The moraines beyond the glacier do not lie close to the valley side, but have an intervening minor valley, the slope of the moraine being least towards the central valley, *e.g.*, 42° on one side and 32° on the other, and 39° on one side and 30° on the other. In the valleys of Norway the moraines are often spread out into flat areas by subsequent floods, and the stones in these are more rounded. He has never seen a glacier eroding a rock basin.

72. Nansen, F.—Observations on the Greenland Ice Sheet.

Rep. Brit. Ass. for 1889, p. 573.

His expedition has crossed Greenland, and found it all covered with ice and snow, reaching a height of 9,000—10,000 feet. The surface is shield shape, without valleys. It has a polished appearance like a frozen sea, but is soft snow on the top. It is kept smooth and level by the wind. The snow never melts except by the direct heat of the sun, and then freezes again at night, making a series of ice crusts, separated by soft snow. It is constantly snowing, and yet the icebergs do not increase. They and the subglacial rivers must keep the balance. The principal way in which the additional snow is removed is by the melting at the bottom by the heat produced by friction against the hidden rocks. He considers the ice fully capable of excavating valleys and fiords.

73. Sherwood, Wm.—The Glaciation of Greenland.

Proc. Birm. Phil. Soc., vol. vii., part 1, p. 63.

A few general observations about the condition of Green-

land. He concludes that the highest land must be in the N.E. The centre of dispersion must be fed by direct precipitation, by which the ice there is kept at its maximum depth. The reason of its being so cold is the absence of warm currents, except in N.E., but if it were depressed new channels would be opened, which would bring warm water and melt all the ice.

GLACIAL THEORIES.

74. Howorth, H. H.—A Criticism of the Extreme Glacial Views of Agassiz and his Scholars.

Rep. Brit. Ass. for 1889, p. 589.

The author objects to the theory of a general ice cap, that—

1. Glacial phenomena are absent from the White Sea eastwards to the Mackenzie River.
2. Nothing corresponding to the drift phenomena occurs in New Zealand or Australia.
3. The great extent of glaciers in New Zealand was contemporaneous with a similar development in the Northern hemisphere, according to the "unanimous testimony of explorers."
4. There is no evidence of former boulder clays, except those found in the Permian beds and in the Miocene [and several others, according to some].
5. The evidence of interglacial beds is inconclusive; the mixture of warm and cold faunas proves a neutral climate [but does this cover *all* the ground?].
6. The ice sheets required would cover up the Scandinavian mountains, and, therefore, the very source of the erratics.
7. Ice sheets could not move so far over such level plains.

[He does not give any alternative theory to account for the observed facts, consequently the glacial theory, if not perfect, may yet remain the *best* one yet offered to account for them.]

PHYSIOGRAPHY.

75. Monckton, H. W.—Note on the Denudation and Elevation of the Weald.

Geol. Mag., Dec. 3, vol. vii., p. 395.

The author discusses the cause of the uprising of the

rocks in the centre of the Weald, and states that "certain of the older beds are thicker in the centre, and gradually thin out to the north and probably also to the south" [there is no evidence of a southern thinning]. He does not see how "a series of successive beds can be deposited most thickly, one after another, on the same spot" [yet immediately proceeds to show how it can be brought about by the depression keeping pace with the deposition]. This line of depression is supposed to change to one of elevation at the beginning of the gault, because the gault has a uniform thickness [though no notice is taken of the gault being a more open sea deposit than any of the lower cretaceous]. This rise, he thinks, was continued so that little or no chalk was ever deposited on the central area [a supposition which would make one naturally ask for the chalk conglomerates]. He then draws a picture of the sea attacking the rising land [of which he produces no evidence], but distinguishes this from the "advance of the sea over land."

76. Irving, A.—Note on the Elevation of the Weald. Geol. Mag., Dec. 3, vol. vii., p. 403.

The author thinks that some outliers on the North Downs may be of Upper Eocene or Bagshot age, and notices that they are not proved to be of the same age as the Lenham Pliocenes, by being of the same elevation, because the west end of the Weald can be shown to have been more raised than the east (1) by the western being more displaced as to dip; (2) by an earlier elevation; (3) by the culminating points rising to the west, as do also the raised beaches. He also shows that the elevation of the Weald must have made some progress before the close of the Eocene, because we have no Miocene in England, and only a little Oligocene [but did we never have?], and because, from the absolute differences between the crag and oligocene fauna, great physical changes must have occurred—England rising, Germany and the West of France sinking. There was a temporary sinking for the crag, but the Westleton beds may be of terrestrial origin, as there is no collateral evidence of such a depression as 500 feet at the time, and there are no marine fossils in the inland gravels, even when preserved from decalcification by Boulder clay.

77. Bulman, H. F.—The Effect of Coal Mining on the Surface.

Journ. British Soc. of Mining Students, vol. xii., p. 130.

A very detailed paper, illustrated by experiments. The general geological inferences are that the shape and dimensions of the zone of subsidence depends on the inclination of the seams, the size and depth of the excavation. "In stratified deposits the zone of subsidence is generally limited by

a sort of dome, which has for its base the area of the excavation."

78. Walford, E.—On some Terraced Hill-slopes of the Midlands.

Journ. Northamptonshire Nat. Hist. Soc., vol. v., p. 1.

This describes a terraced field called Rattlecoombe Slade, at Shennington, near Banbury, and refers also to Gredenton Hill and Beargarden, Banbury. These he wishes to account for by their being hard bands in the lias, so that the porous marls slide outwards. Certain constituents of the marls and marl stones are dissolved, and the surface soil slides down. In the first example, he states that "in each case the top of the slope is crowned by the ferruginous rock-bed of the Middle Lias." [This "explanation" requires explaining, especially when the accompanying figures are examined.]

[**79.**] **Spurrell, F. C. J.**—The Estuary of the Thames.

Paper read to the North Kent Microscopical and Photographic Society on March 26th, but not published in 1890.

80. Hewitt, W.—The Evolution of the Grand Cañon of the Colorado.

Journal Liverpool Geol. Assoc., vol. ix., p. 17.

A *résumé* of the monograph of C. E. Dutton. 1882.

81. Strahan, A.—The Geology of the Neighbourhoods of Flint, Mold, and Ruthin.

Memoirs of the Geol. Survey, chapter xii. The Estuary of the Dee.

This presents the structure known as "valley within valley." The lowest point on which the alluvium rests on rock is near Gorst's Farm, where it is 60 feet below ordnance datum. Near the same spot the glacial beds descend to 285 feet, but the original Dee did not run in its present channel, as there is a rock barrier at Chester, within a few feet of ordnance datum. This has been excavated by the later river when deflected by the great masses of boulder clay. A table is given showing the depths, at various places, of the bottom of the preglacial valley. At the base of the alluvium the boulder clay is eroded and the boulders water worn. A history is given of the changes in historical times which have been recorded, but they have been, for the most part, artificial. Silting up seems to be the natural process.

[**82.**] **Thompson, S. P.**—On the Sources of the River Aire.

Paper read to the British Association on September 9th, but not published in 1890.

[**83.**] **Ulyett, A. H.**—How Great Britain became an Island.

Paper read to the Folkestone Natural History Society on October 21st, but not published in 1890.

THE HISTORY OF CLIMATE.

84. Jäderin, E.—On Variations of Climate.

Geol. Mag., Dec. 3, vol. vii., p. 434.

The author says that 1815, 1850, 1881, were the middle of wet periods, and 1830 and 1860, of dry. A series of observations on the grape harvest for 1400 years, and of the level of the water in lakes and rivers since 1700, fixes the average length of the cycle as 36 years. [He gives no references, and does not discuss the sun-spot period of 11 years or less.] He also says that, from observations recorded since 1826, it appears that each rain period, viz., from 1841-55, and from 1816-85, was followed by a more uniform barometric distribution in space and time, and, *vice versâ*, after the dry periods 1826-40 and 1856-65 [again with no references]. He then attempts to discuss the changes of geological climate, and regards a change of two seconds per century in the position of the earth's axis as involving one as great as 30°!, in course of time [apparently knowing nothing of oscillatory rotation]. He thinks that in early times the earth heated itself and is now heated by the sun.

85. Neumayr, M.—The Climates of Past Ages.

"Nature," vol. xlii., p. 148.

He points out that genera had sometimes wide ranges in climate, and that some forms that are now arctic and others that are now tropic are found in the same secondary rocks. Hence there must be considerable powers of adaptation. This renders arguments from fossils in Mesozoic times doubtful and for Palæozoic times quite untrustworthy. He mentions the reef building corals, which are found in Palæozoic rocks in the arctic regions, in the Jurassic period only as far as England; in the cretaceous to the northern Alps; in the later Tertiary only in Southern Europe, and in Pliocene times, scarcely anywhere. He gets over the argument for decreased heat thence derived by saying:—(1) The corals may have been differently constituted, so as to stand cold; (2) there are no Permian and Triassic reefs known as far north as they should be; or, (3) the earth's axis may have shifted. [In the absence of the slightest proof of these statements (except, perhaps, No. 2), the argument does not appear greatly shaken.] Again, regarding the Carboniferous Lepidodendra, &c., and their wide distribution, even to Spitzbergen, he can only say that we do not know that they required a uniform warm climate. They *may* have lost their power of resisting frost, or have been driven out by the flowering plants. As to the richness of the vegetation, luxuriant plant growth is found in Tierra del Fuego; and the only way in which vegetable remains accumulate in thick beds

now is in the cold peat bogs. [But these are certainly under different conditions from a coal seam.] In tropical regions plants decay too rapidly to be preserved, hence their preservation argues against a high temperature. [But coal is the result of decay, so that the more rapid the decay the more coal is produced.] All we know is that carboniferous vegetation once flourished up to 78° N., and now all the growth is limited by 72° N. and the chief coal beds lie between 30° and 60° N. latitude. The occurrence of a Triassic flora with *Glossopteris* in India, Australia, and South Africa, in carboniferous beds, the base of which is a glacial boulder clay, shows that at that period the distribution of temperature was not uniform. In Tertiary times he shows that the arctic deposits show a difference of temperature from the present of 49° F., and this he accounts for by the shifting of the earth's axis, 10° — 20° in the direction in which the flora does not reach so near the pole, *i.e.*, N.E. Asia. He concludes without reaching any more definite result.

86. Geikie, J.—The Evolution of Climate.

Proc. Roy. Phys. Soc. Edinb., 1889-90, p. 171.

From a consideration of the distributions of the rocks of the several periods he concludes that—

In Palæozoic times, Europe and North America were represented by considerable masses of dry land, massed chiefly in the higher latitudes, with scattered islands further south, and the same was true of other continents. Remarkable uniformity of climate accompanied these peculiar geographical conditions.

In Mesozoic times the primeval continental plateau came more and more to the surface, but the land areas were much interrupted, so that currents from tropical regions continued to have ready access to high latitudes, making the climate more or less uniform.

In Cainozoic times the land masses continued to extend and the sea to retreat from hitherto submerged areas of the continental plateau, by which means the northern temperatures were gradually lowered and the climate was differentiated into zones.

Pleistocene times were characterised by great oscillations, elevations, and submergences; but the arctic shell beds show that the geographical conditions were not the only factor in the climate of the period. The only possible one, in his opinion, is Dr. Croll's theory of the high eccentricity. The reason why this did not produce glacial conditions in pre-Pleistocene times is that the geographical conditions did not aid it, and both combined are necessary. Yet there are evidences of erratics in the Old Red Sandstone, Carboniferous and Permian, to produce ice for which would require very

high mountains—sometimes impossible—unless aided by a cosmic refrigeration.

In Tertiary times the evidence of erratics is more abundant, as the Eocene Alpine blocks brought from Bohemia, the Miocene erratics of the Superga, near Turin; and there are independent evidences of variation in climate without much change of elevation.

The paper is accompanied by four maps of the areas of land and sea in Palæozoic, Mesozoic, and Cainozoic times, showing the gradual increase of the former; and a map of the areas of dominant depression and elevation at the present time; also a geological sketch map of the world.

87. Nathorst, A. G.—Do the Poles change their Position?

"Research," vol. ii., p. 172.

The temperate Tertiary flora of high latitudes indicates that they may; and yet the pole is not entirely surrounded by floras of warmer character. But the Tertiary flora of Japan indicates no change, which is not due, he thinks, to the curvature of the isotherms but to cosmic causes, so that the pole has shifted along the meridian of Japan. He thinks this may be brought about by the shifting of material by rivers, volcanoes, and upheavals. [Certainly insufficient according to the calculations of Twisden.] The pole is actually moving now, for by observations of latitude at Pulkowa and Konigsberg, when compared with those made centuries or even decades ago, they were found to be further south at the rate of second of arc per century. [No such observations are recorded of Greenwich.] This would make 20° in 7,200,000 years [if continued in the same direction], which is half his estimate for the middle of Tertiary times.

PALÆONTOLOGICAL THEORIES.

88. Holmes, T. V.—Notes on the Nature of the Geological Record.

Proc. Geol. Ass., vol. xi., p. 307.

The design of this paper appears to be to show that the Geological Record is still more fragmentary than we are accustomed to regard it; it commences with observations about the permanence of continents; pointing out that the chalk is not a deep sea deposit, but may have accumulated in water less than 300 fathoms deep. Even the thick masses of Palæozoic times were deposited in a subsiding, but not deeply sunken, area. There are many evidences of Europe having been cut up into parts by seas, *e.g.*, in the Eocene times by a sea south of the Mediterranean, and in later times

by the Aralo-Caspian depression. Elevation is also shown by the animals of Gibraltar, though at no time could all the Mediterranean have been dry. The dates of these changes may be sometimes told by the faunas of the islands, of which he takes three types. Britain is not separated from the continent by more than 100 fathoms, and its indigenous mammalia are the same as those of the continent; its separation, therefore, is of recent date. Madagascar is separated by a deep channel, and the mammals are peculiar, and the typical African ones are absent; its separation is, therefore, of ancient date. St. Helena is surrounded by 2,000 fathoms and more, it has no indigenous mammals, and has never been joined to any continent.

He then proceeds to point out the less obvious gaps in the Record. The upper beds of an emerging formation are sure to be denuded, even if no unconformity is stratigraphically provable. He instances the Plumpton rocks, now believed by mapping to be Permian, and which, being stratigraphically conformable, were formerly taken to be Millstone Grit.

Beds may also be re-elevated horizontally, and become apparently conformable, though their upper parts are wanting. This is largely the case in the Coal measures, where beds of sandstone of uniform thickness over a wide area suddenly die out. The Rough Rock has been re-sorted by the sea after its deposition, whereby its remains of land animals may have been destroyed. Considering coals and underclays as indicating a land surface, and shales and sandstone to be signs of depression, the number of oscillations equals the number of the coal seams. Between the Silkstone and Barnsley coal are 12, and from the Barnsley to the Wathwood 10, and this represents only two-fifths of the coal measures. Besides these, the tops of several sandstones may indicate upheavals. The relics of land mammalia under these circumstances would be the first to disappear. Hence, perhaps, their absence.

There *may* be unconformity between the Lias and Trias. [It is doubtful whether he means above or below the Rhætic, for he quotes Ramsay to show there are signs of erosion and sudden change *above* the Rhætic, yet speaks of the planing down of the "interlacustrine land on which the Triassic land-plants, reptiles, and mammals lived," as if the unconformity were *below* the Rhætic.]

The reason why early mammals have not been preserved, is because they are terrestrial, and it is only in exceptional circumstances, such as the lagoon conditons under which the Stonesfield slate was deposited, that we have any chance of finding their remains. [He states that all the mammals are

marsupials, but *Stereognathus may* not be.] In the Inferior Oolite of Yorkshire there are about eight bands of coal, and, therefore, there were terrestrial surfaces. Mammals were certainly in existence then. Yet we get no remains. "How slight becomes the presumption, then, against the existence of mammalia in the Coal Measure times derived from the non-appearance of their remains." The smallness of the forms both here and in the Parbeck is more likely to have been due to local circumstances than to the non-existence of larger forms. Smaller animals are more widely distributed in numbers, and, on their death, the remains of all the animals *of one size* will be naturally deposited *in one place*. Thus, at a later period, the mammals of the Forest Bed are, on the whole, large. But we have no doubt that small ones existed. [There are several other remarks about mammalian remains, the bearing of which is indiscernible, and amongst these he states that the "Lower Eocene" mammals "are almost entirely Marsupial," which is not borne out by either English or French text books.]

Boyd Dawkins has argued that man was not likely to be Miocene, because all the mammals of that age are extinct. "They belong to one stage of evolution and man to another, and a later stage." The author replies that man is associated with Marsupials in Australia, Lemurs in Madagascar, and Primates in Africa [apparently mistaking the word "later" for higher, and then replying to this by showing that later forms in relation to man need not be higher. Dawkins' point is that the associated mammals are *extinct*.]

The absence of man's remains is due to his habits. The most abundant remains are those of Ruminants, who went to the river to drink; and of Carnivora, which went there to prey on them; but man could avoid the beasts of prey by using springs for water, and he had no domestic animals to attract them.

89. Blake. J. F.—On the Inefficiency of Natural Selection for the Origin of Species.

Proc. London Amateur Scientific Society, p. 7.

The geological aspect of the question is dealt with. In a well worked formation there is a richness of species and individuals perfectly comparable with the whole known fauna of the corresponding seas. We cannot, in these cases, appeal to the imperfection of the geological record. The phenomenon of zones in which the succession of species is constant over wide dissimilar areas, and in rocks of many varieties, or takes place in a mass of uniform material, gives no indication of the dependence of species on their environment. If the length of time necessary for the production of a specific change is at all appreciable in relation to the

period occupied by a formation, we are forced to enquire for a scale of the changes necessary to produce a class. In the Carboniferous, there is nothing higher than a reptile; but in the Trias we find mammals. Our scale will give us the requisite number of formations to intervene between the two to bring about the change. Where are they? To push back the origin to a remoter antiquity, is only to increase the difficulty. The earliest fossils are most cosmopolitan, so that the conditions must have been most uniform —yet the greatest changes, viz., the establishment of the different classes, took place in the earliest times. The writer concludes there must be a special cause independent of the environment, and this he calls vitality.

90. Osborn, H. F.—The Palæontological Evidence for the Transmission of Acquired Characters.

Rep. Brit. Ass. for 1889, p. 621.

This deals very largely in generalities and arguments founded on them. The only matter of observation is, that in a series of mammalian jaws from *some* American deposits, belonging to any phylum, the development of new cusps on the teeth takes place where the wear is or would be greatest, the laws being stated as follows:—

1. The primary cusps first appear as cuspules, or minute cones, at the first points of contact between the upper and lower molars in the vertical motions of the jaws.
2. The modelling of cusps into new forms, and the acquisition of secondary position, is a concomitant of interference in the horizontal motion of the jaws.

The theory appears to be that use in one member brings about a tendency in the succeeding member of the phylum to increased growth in compensation. The above is said to be only one illustration of the principle, but none others are given in this paper, and an adverse fact is mentioned that in the development of one of the upper cusps the lower cusp which opposes it is found to recede.

MISCELLANEOUS.

[**91.**] **Strone, W.**—The Deluge, a Tradition of the Glacial Period.

Paper read to the Chester Society of Natural Science and Literature, April 3, but not published in 1890?

[**92.**] **Lupton, A.**—A Gold Mine; a Slate Mine; a Salt Mine.

Paper read to the Leeds Geologists' Association, March 20, but not published in 1890.

[**93.**] **Irving, A.**—Physical Studies of an Ancient Estuary.

Paper read to the British Association on Sept. 8, but not published in 1890.

94. Struthers, T. R.—Tertiary and Post Tertiary Stratigraphy.

Geol. Mag., Dec. 3, vol. vii., p. 397.

There is nothing about *stratigraphy* in the paper. It is entirely concerned with the author's views on classification. All the statements made appear to be second-hand, and there is no evidence that the author has verified them.

[**95.**] **Jeffs, O. W.**—Report of the Committee to Arrange for the Collection, Preservation, and Systematic Registration of Photographs of Geological Interest in the United Kingdom.

Read to the British Association in September, but not published in 1890.

[**96.**] **Chapman, F.**—On the Preparation of Rocks and Fossils for the Microscope.

Paper read to the London Amateur Scientific Society on Oct. 10, but not published in 1890.

[**97.**] **Maw, J. E.**—Report of the Committee for Considering the Best Methods for the Registration of all Type Specimens of Fossils in the British Isles, and Reporting on the same.

Read to the British Association in September, but not published in 1890.

98. Reid, C.—Trial Borings made by the Geological Survey.

In J. H. Blake's Memoir on the Country round Yarmouth and Lowestoft, p. 84.

The tool used differs from an ordinary auger in that it can be turned either way. This is secured by the end of each rod being flattened on one side so as to form a splice with the next rod, and they are secured together by a loose cap, supported by a collar on the upper rod, being screwed over the join to a male screw on the lower rod. Several 9—18 ft. sections are obtained by means of this, and recorded in the memoir.

[**99.**] **Green, A. H.**—Address to Section C of the British Association on the Teaching of Geology.

Delivered Sept. 4, but not published in the Transactions in 1890.

100. Boulger, G. S.—The Methods of Geological Study and Instruction, and the Educational Value of Geology.

Presidential Address to the Society of Amateur Geologists. Proceedings, p. 75.

General observations.

[**101.**] **Deane, G.**—The Future of Geology.

Paper read to the Birmingham Phil. Soc., Oct. 8, but not published in 1890.

102. Carez and Douvillé.—Annuaire Geologique Universelle. Vol. vi., Paris, 8vo.

Give an epitome of English and other Geological works for the year 1889.

TEXT BOOKS.

103. Geikie, A.—"Class Book of Geology." 2nd edition. London. 8vo., pp. 404 (42 lines per page).

This has been "thoroughly revised," so as to keep it abreast of the "onward progress of geology," but no large additions or alterations are mentioned. It is divided into four parts. Part I. the materials for the history of the earth, including the influence of the atmosphere in the changes of the earth's surface; the influence of running water on geological changes, and how it is recorded; the memorials left by lakes; how springs leave their mark in geological history; ice-records; the memorials of the presence of the sea; how plants and animals inscribe their records in geological history; and the records left by volcanoes and earthquakes. Part II. deals with rocks and how they tell the history of the earth. This treats of the more important elements and minerals of the earth's crust, and the more important rocks and rock structures in the earth's crust. Part III. deals with the structure of the crust of the earth, including the original structure and those superinduced in sedimentary rocks after their formation; eruptive rocks and mineral veins in the architecture of the earth's crust, how fossils have been entombed and preserved, and how they are used in investigating the structure of the earth's crust, and in studying geological history. Part IV. gives the geological record of the history of the earth.

Thrust planes and schistosity are dealt with. The only Archæan rocks admitted in Britain are the Hebridean, and some on the west of Mayo and Galway. "In England and Wales a few scattered bosses of old crystalline rocks have been referred to the same ancient series" [and very much more as Pre-Cambrian]. The *Oldhamia* is called a Cambrian fossil, but next to no details of any Cambrian rocks are given. The chapter is a Palæontological one, and yet *Olenellus* is not mentioned, and the Longmynd group is classed in a division marked by the abundance of *Paradoxides*. It is practically the same throughout the book; it is entirely palæontological, and all the stratigraphical information usually given consists of a general table at the end of the chapter.

104. Jukes-Browne, A. J.—The School Manual of Geology. 5th ed. Black, Edinburgh. 8vo, pp. 418 (32 lines per page).

This is said in the preface to have been largely added to and remodelled, and 30 fresh illustrations given. It commences with geological operations now in action, under which are included: the Earth as a whole, Volcanoes, Earthquakes, Rise and Fall of Ground, Minerals and Igneous Rocks, Mechanically formed Rocks, and Rocks formed of plants and animals. Part II. details some of the facts observable in the crust of the earth, such as the Formation of Rock-beds, some results of Consolidation, Inclination, and Curvature of Beds, Faults and Lodes, Metamorphic Rocks, Granitic Rocks, the Origin of Hills and Valleys, Unconformity and Overlap, and Fossils and their mode of occurrence. This occupies half the book. The remainder is occupied by the history of the Formations. He teaches that there are Pre-Cambrian rocks in Carnarvonshire; that the Pre-Cambrian is divisible into Dimetian and Pebidian, and that the Wrekin is part of an Archæan volcano. But he classes the whole of the Longmynd and the Bray Head rocks as Archæan, *i.e.*, he separates them from the Cambrian. He adopts the term Ordovician for the Arenig to Bala Beds. Llandovery rocks are not recognised as forming a large part of the Uplands of Scotland. The Permian is called "Permian or Dyassic system," and is classed with the Palæozoic. The Rhætic beds are classed with the Trias, and the Lias is made part of the Jurassic system. The Lower Greensand is called Vectian, after the Isle of Wight [a term previously proposed for part of the Tertiary beds], but the subdivisions given are not those of the Survey Memoir (1889-90). The change of character of the chalk in Yorkshire is not noticed. Absence of any true Miocene beds is noticed. The Lenham deposits are not mentioned. The shells at Moel Tryfaen are considered to indicate a submergence.

105. Bird, C.—"Elementary Geology." London, 8vo, pp. 248.

An explanation of common terms and structures is first given, and well illustrated by good figures. Next come minerals and rocks—under which head volcanoes are dealt with. Metamorphic rocks are divided into those that are not altered beyond recognition and those that are. The next chapter deals with the weathering of rocks, the solution and removal of mineral matter, the action of rivers, of snow and ice, and of the sea, the internal heat of the earth and its effects —in which Darwin and Murray's explanations of coral reefs are given with corresponding diagrams side by side—and

crushing of rocks is explained entirely by internal cooling, but nothing is said of "thrusts." Two chapters are given to fossils, and the classification of plants and animals. This occupies exactly half the book. The remainder deals with the stratified rocks from Archæan to Pleistocene. In this part, the statements are, perhaps, as correct as can be expected in a small text book, but one or two points may be noticed. The name Silurian covers the whole series, from the Arenig to the Ludlow, without division. *Phacops caudatus* is figured as *Asaphus caudatus* on p. 132, and as *Paradoxides* on p. 133—the latter having been correctly figured on p. 127. *Every* bed of coal is said to rest on underclay, and stems are figured as quite commonly vertical in the roof. The Permian beds on both sides of the Pennine chain are put into one table together. A figure of *Ceratodus* is called *Hybodus*. Good illustrations of Cycads are given on pp. 190-1. The interior of two valves of different genera (one a *Crassatella*) are both given as *Unio*. Good figures of flint sponges appear on pp. 209-10. The Hastings Sand is given as a formation of equal value with the Weald Clay and Lower Greensand. The Lenham pipes are noticed. The figure of a *Cyprina islandica* looks more like a *Cytheræa*.

There is a well-printed geological map, 60 miles to the inch. The explanations throughout are clear and to the point; but the facts stated in the latter part are seen to be not absolutely accurate.

106. Hutchinson, H. N.—"The Autobiography of the Earth." London, 8vo, pp. 290.

This little book aims at giving a popular account of Geological History. The author commences with the Nebular Hypothesis, and then speaks of the doctrine of uniformity as the key of geology. The Archæan period he calls the "archaic era," and the account is necessarily very popular. Chapter 4 is on the "Cambrian slates," with a figure of *Paradoxides*; 5, the slates and ashes of Siluria, including a discussion of general facts; 6, Old Red Sandstone, with the *ancient* figures of *Cephalaspis Pterichthys and Coccosteus;* 7, the Mountain Limestone, with the origin of limestones; 8, Forests of the Coal Period, with a figure showing all the structures found in rare specimens crowded on one slide, and called "coal under the microscope;" also the well-known coal forest restoration; 9, a great interval, during which upheaval and denudation took place, the rate of which latter is explained as a measure of geological time; 10, the Cheshire Sandstones, under which head the introduction of new forms of life is discussed and illustrated by a "geological clock," in which the circle is made of the various formations, and the hand has on it "reptiles and mammals," and points to the

time of their introduction; 11, new phases of life, with figures of the *Plesiosaurus* and *Iguanodon*; 12, Bath oolites, with a general discussion of the origin of oolite and its associated beds; 13, the age of reptiles, with figures of *Ichthyosaurus* and *Archæopteryx*, with a disproportionately long account of Dinosaurs, from Prof. Marsh's works; 14, the Chalk Downs, with a discussion of the origin of chalk, and its difference from Globigerina ooze—this is not figured, but the usual forms of *recent Polycystina* and also *Euplectella* are given, the former as "Flint shells." Figures of *Crioceras* and *Hamites* are also given; 15, a New Era, with a section of the Isle of Wight, and names (often in Latin) of vertebrate forms; 16, the Ice age and advent of man, with an explanation of the proofs of former glaciation, a restoration of Llanberis Pass, and five figures of recently extinct animals.

107. Williams, J. W.—British Fossils, and Where to Seek Them. 8vo. London.

This is a compilation from various text books. It is full of the names of fossils, without saying anything more about them than the class they belong to. The text book references are old, and, therefore, in many cases wrong; and the figures are remarkable for containing numerous fossils which do not occur in Britain. This is published in the "Young Collector's Series," but unless a young collector is very enthusiastic, this book will drive him away from the study of geology; if he is, he will shut it up and go into the field.

108. Wilson, J. S.—Geological Mechanism. 8vo. London, pp. 138.

The author gives 40 pages of autobiography, by which we learn that, in 1854, he communicated observations on California to the Geological Society, being introduced by Sir R. I. Murchison. The history of this is given most naïvely. He subsequently made other valuable observations, but has now launched out into theory, which he would not broach before for fear of "disturbing the faith" of Sir R. I. Murchison, Lyell, and Darwin, whom he "determined to let depart from this life undisturbed in the faith they had." The theory may be judged by the following on the first two pages: "There are volcanoes on the surface of the sun. This being so, why may not the planets have been masses of rock thrown from the sun?" "The original atmosphere was composed of the elements oxygen, silica, alumina, hydrogen, carbonic acid, lime, nitrogen, and other minor elements." As a paradox, this is really worth reading.

109. Darwin, Chas.—Coral Reefs, Volcanic Islands, and South American Geology. London. 8vo.

A reprint of three classical works, with critical introductions by **J. W. Judd.** These are comparatively brief, and rather general in character.

STRATIGRAPHICAL GEOLOGY.

ARCHÆAN AND MONIAN.

[**110.**] **Nicholson, H. A.**—The Geology of the North-West Highlands.

Paper read to the Aberdeen Philosophical Society, Feb. 4, but not published in 1890.

[**111.**] **Durham, J.**—Glencoul, an Example in Highland Geology.

Paper read to the Dundee Naturalists' Society on Nov. 19, but not published in 1890.

112. Hughes, T. Mc.—The Geological Survey of the North-West Highlands.

"Cambridge Review," vol. 12, p. 28. (Not seen.)

113. Reade, T. M.—Geological Notes on the Excursion to Anglesey, April, 1889.

Proc. Liverpool Geol. Soc., Part 2, vol. vi., p. 166.

The North coast was examined. "Some of the purple slates of Yr-Hen-borth are interpenetrated with igneous intrusions along the planes of lamination"; in one case nine sheets in nine inches [but no evidence is submitted that these bands are either igneous or intrusive]. Dr. S. Hyland has examined the section microscopically. The quartz is granulated; felspar can hardly be detected; but there is a little chlorite, iron pyrites, and epodite. The slaty cleavage and original lamination are coincident [but no proof is given that the rocks are cleaved at all]. The [which?] rock at Llanrhwydrus shows a wavy undulating structure. At Camlyn Point is a hard green schist with igneous sheets. On the east side of Camlyn Bay, purple slates and green schists are separated by a dyke, of a specimen of which the "igneous structure, if originally present, is entirely obliterated"; a green slate and harder band are also described from further east. The rocks visible from here to Point Ælianus are briefly mentioned.

114. Holland, P., and Dickson, E.—Notes on an Examination of a few Anglesey Rocks.

Proc. Liverpool Geol. Soc., vol. vi., p. 2.

The rocks are those mentioned above, and have been examined chemically by the authors, and microscopically by **W. Rutley.** The first, I., is from Borth Bay, ten inches below an igneous intrusion. The second, II., is this igneous rock. The third, III., is from an intrusive rock at Porth-y-

Gwartheg; IV. from an intermediate rock; V. from two feet away from the dyke.

	I.	II.	III.	IV.	V.
Silica	70·58	82·48	65·03	65·32	70·74
Alumina ..	13·23	9·48	17·76	16·62	12·79
Ferric Oxide ..	4·23	0·63	2·55	6·63	4·76
Ferrous Oxide	1·24	0·74	1·36	1·05	1·26
Manganese Oxide	0·35	0·83	0·24	0·27	0·38
Titanic Oxide	0·62	—	0·86	0·70	0·41
Phosphoric Acid	tr.	—	tr.	0·13	—
Lime	—	—	0·98	1·10	—
Magnesia ..	1·83	1·11	2·73	1·12	2·97
Potash.. ..	1·92	1·13	2·76	3·25	1·90
Soda	3·52	2·01	2·50	1·46	2·35
Combined water	2·18	1·72	3·16	2·18	2·61
	99·70	100·13	99·92	99·83	100·17
Sp. gravity	2·72	2·60	2·64	2·65	2·65

The first is an ordinary [purple?] slate. The second "consists of microcrystalline felsitic matter of extremely fine texture," with quartz veins [both analysis and description are consonant with its being of non-igneous origin]. The third shows grains of quartz, felspar, and magnetite, and has been deformed; it is spoken of as a "dyke." No. 4 is crushed, and No. 5 is sheared.

An analysis is also given of the Cemmaes Limestone, showing Carbonate of Lime 96·55, Carbonate of Magnesia 0·78, Silica 1·66, Carbonaceous matter 0·23, and other ingredients. It is thus not perceptibly magnesian, and the carbonaceous material is noticeable.

115. Ricketts, C.—Remarks on the Contorted Schists of Anglesey.

Proc. Liverpool Geol. Soc., pt. 2, vol. vi., p. 190.

Suggests that the contortions here observed may have been due to "the deposit in heavier and larger quantity of materials brought down by river currents," pressing down the centre and squeezing out the sides [but this is far too small and local a cause to have had such great and widespread effects].

116. Morgan, C. Lloyd.—The Pebidian Volcanic Series of St. David's.

Q. J. G. S., vol. xlvi., p. 241.

A controversial paper. The author has had the advantage of the 6 in. maps, and has spent a considerable time in examining the coast sections principally. He deals first with the relation of the Cambrian to the Pebidian. This may be studied in four localities. *a.* Caerbwdy Valley. Here the conglomerate lies on red tuff, and the grey porcellanites are higher up the valley. The strikes of all are the same [as they would be in any case after the push from the north]. *b.* St. Nun's Bay. Here the conglomerates at the "arch"

lie upon porcellanites with bands of red tuff [*i.e.*, on a new set of beds], the junction being a "contemporaneous erosion" [for which statement he gives no reasons]. There are numerous little faults here. *c.* Ogof Golchfa. Here the conglomerate is faulted against red and purple schistose tuffs, like higher Cambrian [*not* called Cambrian Sandstone in Blake's figure]. There is not more than 5° difference of strike [nor is there likely to be with so much shearing]. *d.* Ramsey Sound. Between Rhosson and Maen Bachau the conglomerate is in close proximity to basic lava flows, but is faulted. At Maen Bachau there is a fault at the arch, but red sandy Pebidian adheres to the conglomerate. To the south, the latter rests on green Pebidian tuff, and there are many fragments in the conglomerate, but these, he thinks, were also fragments in the Pebidian [but washed out of it]. In Ogof Goch the conglomerate is faulted against silky schistose beds, and then against a rich green rock. At Carn-ar-wig the conglomerate [whose presence was denied by Dr. Hicks] lies on andesitic lava [he has not noticed the agglomerates which it overlaps to reach the lava]. Further west there are thin bands of ashy tuff, both in and above the conglomerate, and "perhaps lavas" [this uncertain statement is not further confirmed]. The ashy tuffs adjoining [*i.e.*, from the context, above] the conglomerate contain pebbles of quartzite [so that it cannot possibly be a tuff, which is vertically descending ash—unless the pebbles were ejected blocks!]. Nevertheless, the field evidence [as above?] and the microscopic evidence [not stated] negative the supposition that these are re-made Pebidian materials. [It is thus seen that the rock in contact with the conglomerate—whether by faulting or superposition—is different in every locality, yet] "the transgression across the subjacent beds is nowhere more than one has a right to expect, where a current-borne material, such as a coarse conglomerate, follows upon soft beds of recent formation." [A matter of appreciation.]

The next question is the Pebidian succession. On the west side, the evidence of dip shows that there is a low synclinal between Pen-dal-aderyn and Pen-y-foel, with a low anticlinal on the N.W. and a sharp inverted anticlinal on the S.E., so that the highest beds are on the outside of the area, but there are numerous intrusions of quartz andesite and diabase, and many faults. The map professes to give the evidence. On the E. side of the Carn-ar-wig fault, twelve N.W. dips are marked and three S.E. dips, one of these being evidence for the northern anticline and the two others for the southern isocline; and these two are not independent, but are continued into a reversed dip. [But there is no proof given *which* side is reversed.] On the W. side of the Carn-ar-wig

fault two small synclines are noted, but with vertical tuffs between, striking perpendicularly to both, so that the real lie of the rocks is very obscure. Near Pen-y-foel, one of the felsite dykes is a spherulitic granophyre, and is associated with tuffs. These, on analysis, yield:—

	Felsite.	Tuff.
Silica	72·30	74·09
Alumina	12·09	14·98
Iron Oxides	2·16	1·80
Magnesia	2·02	1·50
Potash	4·80	1·27
Soda	3·41	6·07
Pyrites	0·90	—
Loss	1·69	1·31
	99·37	101·02

He then considers the relation of the Pebidian to Dimetian. At Ogof-Llesugn he cannot see the Cambrian bend up [!]. It is overlaid by red Pebidian [altered Cambrian?], and "highly-altered Cambrian" and "much altered Pebidian" are "seamed with diabase dyke material," some of which he thinks may be Pebidian in part; yet he concludes "the Dimetian was intrusive" to bring about the alteration. [He does not explain how it is that the conglomerate, of all the beds, should lie, both inland and on the coast, in intimate relation with the "Dimetian" as well as with Pebidian.] He concludes that Pebidian is a sub-group of Cambrian, whose base is nowhere seen—and therefore there are no Archæan rocks at St. David's.

117. Blake, J. F.—On the Monian and Basal Cambrian Rocks of Shropshire.

Q. J. G. S., vol. xlvi., p. 386, pl. 16.

The Longmynd series is divisible into two parts. The lower consists of five groups: 1. The Dark Shales; 2. Banded Series; 3. Purple Slate; 4. Hard Greywacké; 5. Pale Shales and Grits. The actual dip of these is fairly uniform towards the west, and that this is the real dip is shown by the concavities of the rain spots facing west, and the overlying grits most resembling Nos. 4 and 5, which are therefore probably highest. The lowest group is not a basal deposit, and therefore must be towards the upper part of a complete series. It cannot be immediately derived from the volcanic rocks on the east. Obscure *Lingulæ* have been seen in No. 1, and little curling annelid castings occur on one of Salter's specimens. The supposed Trilobites *Palæopyge*, &c., are merely smooth surfaces of separation, with accidental outlines. The outlier at Pitchford is probably No. 2, and the eastern part of Haughmond Hill No. 5.

In tracing the junction between this series and the overlying, the great conglomerate is not found to lie at the base,

but there is a band there with purple slate fragments. The upper grit is first seen on the north, in an outlier S. of Woolstaston. It begins again half a mile to the west in Hawkham Hollow, but is traceable southwards, crossing to the east, leaving inliers of No. 5. Near Narnell's rock, on the S. side of Ashes Hollow, the junction may be seen, but no grit is found on the northern side of the same Hollow. In Callow Hollow the lower beds cross the valley bottom nearly vertically, but the grit is found in the hill slopes above, crossing the edges of the former series, the line of junction being a clearly horizontal one in Minton Batch. The same thing is seen in the western slopes near Asterton. But opposite Mindtown Farm there is an appearance—supposed delusive—of conformity. Towards the south the grits come into relation with Nos. 4 and 3. Near Horderley the red grit is seen in relation with No. 1, and it is the same red grit which passes by Wartle Knoll to Aston. If all these red grits be the same, there is a marked unconformity. The western or upper part of the Longmynd rocks is divisible into three groups: (1) Red grits and conglomerates without definite bedding; (2) massive purple slates; and (3) red grits with smaller masses of conglomerate. The lower conglomerate pebbles are, as to 95 per cent., of quartzite, not to be matched in any exposed rock in the district. The remainder are derivable from the Volcanic rocks on the east, or are of doubtful origin, only *possibly* from the underlying series. There are also gneissose and schistose pebbles. The massive purple slates have a N.W.W. strike; they are very thick towards the south, but interosculate with the grits on either side, and ultimately die out towards the north, showing no sign of a fold. The upper grit contains discontinuous bands of conglomerate on various horizons. The pebbles are almost entirely quartzite, except near Lyd's Hole. Here the dip is reversed near a fault, but to the south the dip becomes as low as 20° to the west.

On the west of these grits come the spots where Dr. Callaway described bosses of Archæan rocks. The mass at Pontesford Hill is separated by compact slate dipping W., and at Lyd's Hole there is intrusion and alteration. At Gatten Lodge there is an infiltration of Baryta. Knoll's Ridge and Cold Hill are rhyolites, which cross the strata and run into the overlying pale slates. At Chittol Hill these pale slates are indurated. On the west side of West Onny River, by Linley Drive, the gradual passage from grits to slates may be traced.

The question is next discussed as to the age of the rocks forming the volcanic hills. The long straight fault passes in the midst of the dark shales E. of Church Stretton, and does

not affect the question. The dark shales are not at all the kind of rocks to be derived from the volcanic rocks, and nowhere contain conglomerates, and there are several patches of what appear to be altered slates amongst the rhyolites &c., especially on Little Caradoc, and none such are found on the eastern part. The volcanic rocks have therefore been extruded from amongst the slates. The crystalline rock of the Ercal, and elsewhere, is thought to be intrusive, but at Ercal itself, the only junction seen is faulted. At Wartle Knoll the igneous kernel probably belongs to the same group as Caradoc. On Ragleth, Cardington, Willstone, and Caradoc there are patches of red grit. The conglomerate of Charlton Hill is entirely isolated and quite local; it is folded in with the surrounding rocks, but is of later, but not much later, date. Still earlier are the fragmental beds of Woodgate, the S. of the Wrekin and Lawrence Hill, which even come to form part of the volcanic series. On Cardington there is porphyry, intrusive both in the volcanic series and the grit, also basic rocks, which may be, but are not necessarily, of still later date.

The schists at Rushton may be older than any of the rocks yet dealt with, but there is no stratigraphical evidence. The masses of gneiss, mica schist, and hornblende schist at Primrose Hill are so small that they may be fragments brought up in a neck.

The Cambrian quartzite never crosses to the west of the volcanic group, and was probably always limited to the eastern side, and in the same way the oldest rocks of the Longmynd have ever since formed a nucleus up to which succeeding formations have come, but have never passed over.

The general conclusion is that the eastern Longmynd rocks represent the Upper Monian, and the volcanic rocks occupy an intermediate place between this and the Lower Cambrian, and if classed with either may perhaps be preferably grouped with the latter.

The map shows the distribution of all the rocks discussed, on the scale of one inch to the mile, and is based on the Ordnance Survey.

118. Blake, J. F.—On the Base ot the Sedimentary Series in England and Wales.

Geol. Mag., Dec. 3, vol. vii., pp. 308, 354.

This is a summary of the work done, and the conclusions established, according to the author, in the various districts where Pre-Cambrian rocks have been recognised, viz., St. David's, Anglesey, North-west Carnarvonshire, Malvern, Shropshire, and Cornwall. With regard to St. David's, the conclusion arrived at is that the whole of the Pebidian group

is distinct in character from the Cambrian rocks, and there is an interval of time between them, but how great this interval may be is an open question. In Anglesey, a distinct system of rocks, named by the author Monian, he thinks established, but is not certain whether any of it can be identified with the Pebidian. In the North-west Carnarvonshire district, the results are similar to those indicated on the Survey map, except that the igneous rocks are not intrusive, and the adjoining Cambrians are not exceptionally altered. On the Malvern district nothing is added. In the Shropshire district, the author has had to change his views from facts observed, having formerly thought the "Uriconian" older than the Longmynd rocks, but he has now found the latter divisible into two parts, and the "Uriconian" intermediate between them. On Devonshire and Cornwall he has practically nothing to say.

119. Hicks, H.—The rocks of St. David's.

Geol. Mag., Dec. 3, vol. vii., p. 401.

The author objects to a statement by Blake (in the above), that the Cambrian conglomerate at St. David's is not composed of fragments of the rocks on which it lies, and quotes the observations of Professor Bonney and Mr. Davies to the effect that "the sections contain numerous fragments of felspar, very similar to that in the Dimetian; in short, they present every appearance of an arkose," and "the Cambrian conglomerate encloses much waterworn *débris* of the Dimetian."

120. Hicks, H.—On Pre-Cambrian Rocks occurring as Fragments in the Cambrian Conglomerates in Britain.

Geol. Mag., Dec. 3, vol. vii., p. 516; read at the British Association on Sept. 5.

This is a general re-statement of his views, and the facts he relies on to prove them. He admits now that the "Dimetian" "must have had an igneous origin." He gives a table showing the occurrence of twenty kinds of rock in seven different areas. Pembrokeshire, Merionethshire, Carnarvonshire, Anglesey, Shropshire, Ross-shire, and Sutherlandshire, showing only twenty-nine vacant spaces, so that sixteen varieties of rock are present on an average in each locality. [No details are supplied for verifying the statements.]

121. Blake, J. F.—The Cambrian Conglomerate of St. David's.

Geol. Mag., Dec. 3, vol. 7, p. 525.

He explains that, in stating that the conglomerate is not mainly composed of fragments of underlying rocks, he means by fragments the "pebbles" and not the "matrix," and that to "contain" is not to be "mainly composed of."

122. Hull, E.; Nolan, J.; Cruise, R. J.; McHenry, A.—Explanatory Memoir of Inishowen, County Donegal.

Memoirs, Geol. Survey, Chapters I.—IV., and Appendix B. Plates I—IV.

E. Hull says that some of the conglomerates and grits "remind him of some of the coarser grits of the Bala-Caradoc group of North Wales." He considers it probable that "the beds of quartzite, crystalline schist, and limestone are altered Lower Silurian beds." Some of the quartzite beds show "apparent annelid tubes."

J. Nolan describes the Londonderry district. We learn that there are mica schist, slates, micacized grits, and conglomerates in various specified localities. They are seldom highly metamorphosed, the rock in many places being merely a shining slate. In some places there is steatite schist used for lining ovens, and known as Carnstone. All the rocks are much cleaved. Near Cloghan and elsewhere is a green igneous-looking rock, but really containing water-worn fragments. The conglomerates are also schistose, and there are also on Loch Island beds of limestone and calcareous schist. [This district has been described by Dr. Callaway, Q. J. G. S., vol. xli. It does not appear that there are any true schists, only mylonized beds, but no stratigraphical details are given.]

R. J. Cruise describes North and East Inishowen, and gives the apparent order of succession. Torbeg, Tormore, and Inistrahull contain hornblendic gneiss which closely resembles the Archæan rock of Canada and Sutherland. Apparently above this, at Malin Head and southwards, comes the First Quartzite series; they are felspathic, of a pink colour, and pass on to gneiss; further west there are beds of mica schist among them. The lowest beds of the First Schist series overlie these; they are micaceous, talcose, and chloritic, and are much crumpled and contorted. The Second Quartzite series differs markedly from the quartzite of Raghtin More, being much more felspathic and having numerous beds of micaceous and felspathic schists and coarse grits associated with them. Near Culdaff the following order is made out:—

1. Flaggy quartzites.
2. Thick-bedded quartz rock.
3. Quartzites and quartz schists, with thin bands of felspathic schist.
4. Flaggy and micaceous quartzites.
5. Quartzites and quartz rock, with thin beds of talcose and micaceous schists.

At Knockglass there are calcareous schists with thin bands of black shales. The Second Schist series differ essentially from that under the quartzites. They are in many places

little altered, and contain numerous bands of coarse grit. At Durnore Head the succession is—

1. Mica-schist, crumpled.
2. Talcose and micaceous schists.
3. Blue thin flags, quarried for tombstones.
4. Quartzose grits, highly altered.
5. Micaceous schists.

Limestones are found both in the series of schists and quartzites; their greatest development, however, is at Culdaff, in the Middle Quartzite series. Here they lie in a synclinal trough, formed of the upper beds of the quartzite. Patches of dolomite are of frequent occurrence.

A. McHenry describes the Moville district. Here the beds consist of various phyllites or argillaceous schists, grits, and conglomerates, all of which are cleaved, and steatitic beds are occasionally met with. The rocks generally in the district are so slightly metamorphosed that they might be expected to yield fossils, but none have been found.

E. Hull describes, in the Appendix B., the "coral-like forms in the Limestone." These were first found in 1856. The specimens have been sent to various palæontologists and photographs to others. Of those who have examined them, W. H. Bailey indentified them as probably *Halysites* [to which they appear to have no resemblance]. Messrs. Sharman and Newton "have been unable to recognise among them any satisfactory evidence of organic structure." A. C. Haddon "could not discover any evidence which would enable him to assert their coral structure." H. A. Nicholson says one "certainly appears to be an auloporoid-coral," but of the others he is "not prepared to say what they are." J. Hall recognises corals of the family *Favositidæ*. C. D. Walcott recognises four as belonging to *Favistella stellata*, and the fifth to *Tetradium fibratum*. A. R. Selwyn finds it impossible to express an opinion as to their organic nature, and so do J. Whiteaves and W. Dawson. E. Hull himself says that "the evidence upon which the organic origin of the forms from Culdaff is based consists of two kinds, namely, direct evidence offered by form and structure, and circumstantial, based on mode of occurrence [about the latter he does not say a word]. The structural evidence is based on the radiating form, and on the recognition of tabulæ perpendicular to the walls of the supposed tubes. [Of the figures shown on Plate I., only Fig. 2 has any real resemblance to a coral; the white (calcite) lines on the others are too irregular to prove anything. The figure on Plate II. is the same as Plate I., Fig. 4, and differs entirely from the American form of *Favistella stellata*, which is placed beside it for comparison; Plate III., Fig. 2, which is compared with *Favosites fibrosus*

from Wexford, really does look very like in the figure, and so does Plate IV., Fig. 1, but Figs. 2 and 3 do not add anything].

123. Hull, E.—On the Presence of Coral-like Forms in the Crystalline Limestone of Inishowen, co. Donegal.

Rep. Brit. Ass. for 1889, p. 577.

The specimens referred to are found in the limestone of Culdaff. No description of them is given. Photographs have been submitted to several foreign geologists, who "pronounce the specimens to be coralline." Dr. Newberry refers them to *Favistella*. Dr. Romer to *Favosites*. Certain British geologists to whom they have been shown "give only a hesitating assent to the view of their organic origin." No list is here given of those who think them inorganic.

[**124.**] **Hull, E.**—On the Coralline Forms from the Culdaff Limestone, as determined by Prof. James Hall and Mr. Chas. Walcott, of the U. S. Geological Survey.

Paper read to the Royal Dublin Society, Feb. 19, but not published in 1890.

125. Hull, E.—Geol. Mag., Dec. 3, vol. vii., p. 144.

The coral-like structures in the Culdaff Limestone have been identified by Messrs. Hall and Walcott as belonging to the corals *Columnaria* and *Tetradium*.

CAMBRIAN AND SILURIAN.

[**126.**] **Andrews, W.**—On the Discovery of Blue Slate in the Cambrian Rocks in North Warwickshire.

Paper read to the Warwickshire Naturalists' and Archæol. Society on March 24. Published in Proceedings?

127. Gunn, W.—The Geology of the Country around Ingleborough.

Memoirs Geol. Survey, chapter ii.

The bases of some of the valleys show Silurian rocks, which have been described by Phillips, Sedgwick, and Hughes. The Lower Silurian is found in Chapel-le-dale and Thornton Beck, where are seen a series of greenish grits and slates, surmounted with limestone and calcareous shales, dipping at a high angle, 50°—80°, to the S.W., or sometimes reversed, and having a thickness of about 10,000 ft. In the grits, there is a band of conglomerate at Twisleton Dale House. Other lower ones cause waterfalls. The limestones have fossils of a Coniston facies, and the beds below have been called "green slates." The elements of these slates are always water-worn, and they offer a marked contrast to beds in a corresponding position in the Lake district. They contain also quartz and mica, which are absent in the latter.

There are other small exposures of Coniston Limestone in Jenkin Beck, and near Crummack, on the summit of an anticlinal, and near Horton, where high dipping grits and mudstones, like those of the Coniston Grit, are exposed irregularly below the Drift. The fossils recorded from this last locality are:—

Heliolites interstinctus. *Wahl.*
Monticulipora fibrosa. *Goldf.*
Streptelasma æquisulcata. *M'Coy.*
Cybele verrucosa. *Dalm.*
Orthis biforata. *Schl.*
——— calligramma. *Dalm.*
——— elegantula. *Dalm.*
Leptæna sericea. *Sow.*
——— transversalis. *Wahl.*
Lingula ovata. *M'Coy.*
Orthis actoniæ. *Sow.*
——— flabellulum. *Sow.*
——— vespertilio. *Sow.*
Strophomena grandis. *Sow.*

Upper Silurian rocks occur in the Crummack area. The base is taken as a thin conglomerate at Austwick Beck Head, over which are slates and flags. The "Stockdale shales" are absent here, and the "Wharfe Grits" do not enter the map. The dip is south, from 15°—40°, and the thickness 800—900 ft. They belong to the Lower Coniston Flags, and contain a band of Whetstone, described by Sedgwick and Marr. In Ribblesdale, these slates and the Middle Grits are seen, of which a section is given with the highest beds, near a fault at Horton Wood.

128. Cole, G. A. J., and Holland, T. H.—On the Structure and Stratigraphical Relations of Rhobell Fawr.

Geol. Mag., Dec. 3, vol. vii., p. 447.

Rhobell Fawr and Moel Cors-y-garnedd are two neighbouring eminences which have Lingula flags for their base, and the main mass consists of ashes and conglomerates, with handsome hornblende crystals. The authors have found, on the summit of both hills, some bands of quartzose grit, containing rolled lumps of andesite, resembling those of the less basic tuffs below, and pebbles of black shale. These grits they identify with one at Allt Llwyd, on the other slope of the Mawddack, which overlies imperfect slates, regarded as Tremadoc, with Lingula flags still lower. It contains similar black slate pebbles. Above it, at a short distance, comes the Arenig volcanic series. On this evidence, they conclude that the true age of the Rhobell Fawr ashes is Tremadoc. They give a section to true scale, showing Moel Cors-y-garnedd let down by an oblique fault.

129. Wilson, J.—Birkhill Fossils at Inverleithen, Perthshire.

Trans. Edinburgh Geol. Soc., vol vi., p. 113.

C. Lapworth, in drawing a section across the southern uplands (Geol. Mag., 1889), represented Birkhill shales as coming to the surface in a wrinkle at Walkerburn, Inverleithen—the only evidence at the time being the presence of the characteristic *Rastrites Maximus.* The rocks here are

very different from those at the typical Birkhill section, so that the correlation has been considered hazardous. Now, however, in a quarry one mile to the east, and apparently on the same strike, a nest of shale has been found between two beds of grit. This shale contains graptolites, which are named by Lapworth as *Monograptus cyphus*, *M. argutus*, *M. leptotheca*, *M. crenularis*, *M. tenuis*, *M. gregarius*, *M. attenuatus*, *Climacograptus normalis*, and there are also *Dawsonia campanulata*, *Discinocaris Browniana*, and an *Ontroceras*. These are characteristic fossils of the "gregarius" zone, and thus the reference of these beds to the Birkhill shales is confirmed.

130. Strahan, A.—The Geology of the Neighbourhoods of Flint, Mold, and Ruthin.

Mem. of Geol. Survey, chap. ii. Upper Silurian Rocks.

The whole of the Moel Fammau range is composed of Wenlock shale. The cleavage is parallel to the local strike, but not quite to the general strike. It follows that the minor folds were first formed by N.N.E. and S.S.W. pressures leading to cleavage, and the whole was upheaved at a later date, along a line whose near coincidence with the former is accidental.

He mentions the following exposures:—The ravine of Coed Coechion; Maes Mynau; Moel-y-parc; Caerwys, a cirque on south side of the Grove Valley; Pen-y-cloddiau; Plas Yw, where nodular structure is developed along the planes of cleavage; Moel-Llys-y-coed, a hard micaceous sandstone; Penmachno, tried for slates; Bwlch-y-cilcain, to the south of which are veins tried for copper; Moel Fammau grits; Moel-y-Gaer, is an outlier of contorted shales, with slate quarries. South of this hill, a quarry shows flags with *Orthoceras primævum* and *Cardiola interrupta*.

[**131.**] **Watts, W. W.**—The Geology of the Long Mountain, on the Welsh Borders.

Paper read to the British Association on Sept. 8, but not published in 1890.

132. Watts, W. W.—The Breidden Hills and their Igneous and Associated Rocks.

Proceedings of the Powys-land Club, vol. xxiv., p. 107. A reprint from the Q.J.G.S., vol. xli., p. 532, with alterations.

The chief alterations consist in his using the term "Ordovician," instead of "Cambrian," for rocks of Bala age, and stating that the older igneous rocks are intrusive and not lava-flows as before believed.

[**133.**] **Morgan, J. B.**—On the Strata forming the Base of the Silurian in North-east Montgomeryshire.

Paper read to the British Association on Sept. 8, but not published in 1890.

134. La Touche, J. D.—The Passage Beds of the Stokesay District.

Paper read to the Caradoc Field Club, May 30, and reported in the local newspapers.

[**135.**] **La Touche, J. D.**—The Geology of the Lower Ludlow Formation and the Passage Beds at the Summit of the Silurian Series and below the Base of the Old Red.

Paper read to the Woolhope Naturalists' Field Club, but not published in 1890.

136. Marr, J. E.—The connection betwixt Yorkshire and Scandinavia.

"The Naturalist," p. 145.

In this the author draws attention to the floor of old slates on which the mountain limestone of the neighbourhood of Ingleton rests. The oldest are green slates, over which lie calcareous shales, the equivalent of the Coniston Limestone and *Trinucleus* shales of Sweden, the species occurring abundantly at Norber; as also *Dindymene*, a Swedish trilobite; and *Dicellograptus anceps*, a Swedish graptolite. The beds referred to the Llandovery contain *Phacops elegans*, characteristic of equivalent beds in Norway; and at Sedbergh are graptolitic shales. The flags in the Wharfe Valley are Wenlock, with *Monograptus priodon* and *Retiolites geinitzianus*; above are grits, comprising the Moughton whetstones, and containing *Monograptus nilssoni* and *M. dubius* of the Scandinavian Ludlow series, and finally the quarries of Ribblesdale contain higher flags with *M. colonus*, *M. Ræmeri*, and *M. bohemicus*.

137. Hicks, H.—The Effects produced by Earth Movements on Pre-Cambrian and Lower Palæozoic Rocks in some Sections in Wales and Shropshire.

Geol. Mag., Dec. 3, vol. vii., p. 558. Read to the British Association on Sept. 5.

General statements, without details, on the line from St. David's Head to St. Bride's Bay. "The Arenig rocks" are said to be "separated from the Tremadoc by a thrust fault which has diminished the thickness of the strata by about 1,500 feet." In Shropshire, "Lower Palæozoic rocks are" said to be "faulted on the W. side so as to appear to underlie the Pre-Cambrian rocks of Caer Caradoc." [These statements have received no proof, and are at variance with the observations of others. Yet "some geologists make serious errors" from not recognising these "facts."]

(HISTORICAL AND CONTROVERSIAL.)

138. Dana, J. D.—Sedgwick and Murchison: Cambrian and Silurian.

American Journal of Science, 3rd series, vol. xxxix., p. 167.

This paper purports to be a brief history of the Cambrian and Silurian labours of Sedgwick and Murchison. In 1834, the five primary divisions were laid down by Murchison, including the Longmynd. In 1835, "Cambrian" and "Silurian" first appear in Geological literature, the latter in the Phil. Mag. for July, and the two together in August at the British Association. The "Upper Cambrian" was then found in the Berwyns; the "Middle Cambrian" in the higher mountains of Carnarvonshire and Merionethshire; the "Lower Cambrian," in the S.W. of Carnarvonshire [*i.e.*, the Lleyn] and was composed of schists. Sedgwick's first detailed paper was in May, 1838, where the "Lower Cambrian" = the previous Middle Cambrian. The previous "Lower Cambrian" he now calls "Protozoic." In the end of the same year, the Silurian system of Murchison appeared. In this the Upper and Lower divisions are brought out, and the mass of organic remains in each is said to be very distinct. In 1842-3, Murchison stated in his presidential address that there seemed no other fauna in N. Wales than the Lower Silurian. From this time to 1846, Sedgwick admitted that the "Bala beds must be Caradoc," on the evidence of the fossils determined by Salter. In 1843, Sedgwick wrote a paper "On the Older Palæozoic (Protozoic) Rocks of N. Wales," in which he makes no mention of Cambrian at all, and uses the term Protozoic, not in the sense in which he had himself proposed it, but in Murchison's sense—for the whole series of Silurian rocks and all fossiliferous ones below. [In other words, Sedgwick, at this date, *withdrew* the term Cambrian from Geological nomenclature.] His map distinguished "Upper Silurian," "Protozoic," and "Mica and Chlorite Slate;" in the publication of it there was printed —instead of "Protozoic"—"Lower Silurian (Protozoic)." [If Sedgwick did not write this, still the term "*Upper* Silurian" implies that the beds below are "*Lower* Silurian," and he acknowledges elsewhere to be able to draw no line of separation between these and "Cambrian."]

In 1852, Sedgwick says he suspects he may have written "Lower Silurian and Protozoic" [but this is unlikely, as his *own* Protozoic originally meant the "Mica and Chlorite Slate," while Murchison's *included* the Silurian. Moreover, it is contrary to his printed words. The "rocks," which "the author terms in his present paper the *Protozoic* group, extend in an east and west direction from the borders of Shropshire to the western coast of Carnarvonshire"—*i.e.*, includes all beds called Lower Silurian, and takes the word in Murchison's sense]. In 1846, Sedgwick re-introduces Cambrian, protesting

against the downward extension of Silurian. He divides it into:—1. Tremadoc; 2. Snowdonian; 3. Bala or Upper Cambrian; 4. Cambro-Silurian. [That is, the faulted Arenigs are called Tremadoc, and said to underlie the Llanberis slates. The rocks of Snowdon are supposed to underlie the Llandeilo and Bala instead of being composed of them, and "the Caradoc sandstone of the typical country of Siluria and the Llandeilo flags of S. Wales" are placed above the Bala beds, and it is said to be "an incomparably greater error to regard them as the *equivalents* of all the lower groups," though they are, in fact, the equivalents of the greater part of them; and he includes in the Cambro-Silurian group the "slates and grits (Caradoc sandstone of Noeth Grug)" and the "Upper Llandeilo Flag"—which are the Llandovery and Wenlock beds. In other words, the series is still in complete confusion.] Murchison replied to this, and, in 1852, Sedgwick presented his case again, chiefly in an historical manner, and claimed the Cambrian series as his own by the undoubted right of conquest. [Had he really *ever* surmounted their difficulties?] Murchison replied in June. In 1853, the synopsis of the British Palæozoic rocks was published, giving another new classification, and in the same year Sedgwick pointed out from the observations of M'Coy that the May Hill sandstone was not Caradoc, but Upper Silurian [*i.e.*, that the dividing line should be drawn below and not above it]. The conclusion is that all down to the Llandeilo should be called Silurian, all below Cambrian, and that there is no room for "Ordovician" between.

139. Hughes, T. McH.—In Life and Letters of Sedgwick, chapter viii., "Sedgwick's Geological Work."

The interest of this consists in its supplying us with all that can be said on the *personal* side as to the use of the term *Cambrian* for Llandeilo, Bala and associated beds. The author gives a "diagram to show the variation of Cambrian and Silurian rocks in North and South Wales, representing A, Crystalline Archæan, as primeval land in the centre, and on its flanks B = Harlech, Menevian, Festiniog, and Tremadoc; above this "there is a greater change in the sediment and forms of life, which it is convenient to indicate by a new bracket C" = Arenig, Bala, and above Bala; and D is Denbigh Grits, containing a "*Cardiolan* Fauna." In the south, there are few volcanic rocks on the Arenig horizon. The Upper Bala is more sandy, and is succeeded by May Hill Sandstone, then by fossiliferous Wenlock beds. These differences misled the workers.

In 1831, Sedgwick drew an unpublished diagram showing a sharp synclinal on the top of Snowdon. In 1832, he showed that the fossiliferous trough of Snowdon was many thousand

feet above the Llanberis slate quarries [that is, he is now said to have done so—his account not having been published]. He also then drew a sketch section showing anticlinals and synclinals from Carnarvon to Bala [not published, but sent to Murchison. All above the porphyry of Mynydd Mawr he describes as "slate and porphyry blended together in endless confusion," and there is no classification or correlation.] This is then compared with the Geol. Survey section of 1858, and it is stated that "they have not given very much additional information." [The difference is that they have determined an order of sequence, and *name* the beds accordingly.] "This sketch was in Murchison's hands when he was directing the work of the survey" [but it could have been of no use, as it does not indicate any subdivisions]. "We claim for Sedgwick that he had in 1832 explained the geological structure of N. Wales, and has sketched out the leading sub-divisions of the Cambrian rocks." [He does not so express himself, and makes *no* subdivisions.] "In a letter dated November 15, 1832 [not printed] he explained the exact position of the Wenlock Limestone south of Llandovery." "Murchison, however, sometimes acknowledged the pence due to Sedgwick, but forgot to mention the pounds. In this case, it would appear that Murchison had forgotten" [this is an insinuation which the statements hitherto made do not appear to justify]. In 1833, Murchison brought out the subdivisions Upper Ludlow, Wenlock Limestone, Lower Ludlow, Shelly Sandstones, Black Trilobitic Flagstone, and Red Conglomerate Sandstone and Slaty Schist.

Next year he corrected some detailed errors, but still included the May Hill rocks with Caradoc. "Sedgwick had not been obliged to make any important changes in his Bala section." [Because there was nothing sufficiently *definite* in it to change.] "Murchison had already found it necessary to alter his arrangement, and to change the details of almost every section." [Because he went forward and kept improving his work. It seems hard to throw a man's own improvements in his teeth.] In 1833, Sedgwick read a paper to the Cambridge Phil. Society and both showed sections to the British Association. [But in these sections of Sedgwick we get no further than "saddles and troughs," whose direction is discussed, while the succession of the strata is unnoticed.] This and the next year, Murchison did all the main part of his work. In the latter year, they went together to North Wales—but nothing came of it. "For several years the question remained in much the same state, Murchison's Upper Silurian being made up of Ludlow and Wenlock, and his Lower Silurian of Caradoc and Llandeilo, Sedgwick not believing yet that Murchison's sections and

grouping could be fundamentally wrong." [It is not stated, nor can it be divined, in what respect they were fundamentally wrong.] After a reference to later writings, comes this—"The point was that Sedgwick had correctly described and determined the position of all the Bala series as early as 1832; that the section then put forward has never been changed, and the classification founded upon it is that which is now everywhere known to be correct." [That is, Sedgwick's claims are rested on an *unpublished* section, in which the position of the Bala series, *in a vertical sequence*, are not defined at all, which the author drew to "amuse" Murchison, and probably thought no more of, and in which no classification is put forward at all, to be either right or wrong.] In 1835, the name Cambrian was used, but the Upper Cambrian is only defined as shales of the Berwyns and Balas, and the Lower Cambrian as roofing slate, &c. [*i.e.*, there are no real subdivisions determined by order of superposition, no fossils, nothing, indeed, which goes to found a system.] The history after this point becomes intolerably complicated and wearisome. According to the author, Sedgwick was always right, or his statements were "tentative." Murchison is constantly "wrong," and his statements "erroneous." He is accused of mixing the fossils of one bed with those of another, and of inverting in one place the order of superposition. [These accusations may be true, but Murchison collected and described the fossils, and so gave a basis for comparison, and it is not too much to say that Sedgwick's work was only orographical, and thus the Cambrian rocks, as a geological system, were left unintelligible *except by comparison with the Silurian*. The real and only observers who brought geological order into North Wales were the geological surveyors.]

DEVONIAN.

140. Ussher, W. A. E.—The Devonian Rocks of Great Britain.

Rep. Brit. Ass. for 1889, p. 578.

The Devonian rocks of the South West of England are divisible into three typical areas. 1. The Northern area—characterised by the presence of arenaceous deposits, indicative of shoal water. 2. The Southern area, showing great variability, with sporadic volcanic eruptions and local coral reefs, arenaceous deposits being confined to the Lower division. 3. The Western area, a uniform deposit of muddy sediment.

He gives the following table of correlations :—

	Franco-Belgian.	North Devon.	South Devon.	Cornwall.	German.	
Upper Devonian.	Fammenian Slates & Psammites in four zones; of *Spirifer distans*, *Rhync. ætiensis*, *R. Dumonti*, *R. omaliusi*.	Pilton Beds. Baggy Beds.	Druid Slates. Livaton Slates. ClymeniaSlates. CypridinaSlates	West Littor Slates. S. Pethenon Slates. Greenish Slates.	Ludwig's Fucus Sands and Knollen Kalk. Cypridinen Schiefer.	Upper Devonian.
	Frasnien Schists with *Cardium palmatum*. Limestones with *Rhync. cuboides*.	Pickwell Down Beds. Morte Slates.	Slates with tuffs. Saltern Cove Beds. Upper Chudleigh Limestone. Lower Chudleigh Limestone.	Grey Slates with tuffs. PaleGreySlates.	Goniatiten Schichten and Adorfer Kalk. Iberger Kalk.	
M. Devonian.	Givetien or Givet Limestone.	Ilfracombe Slates.	Stringocephalus Limestone or Ashburton Volcanic Series.	DarkGreySlates with *Heliolites porosa* and Calcareous Nodules.	Stringocephalus Kalk.	Middle Devonian.
Lower Devonian.		Combe Martin Slates.	Hopes Nose Limestone.	Yellow and buff Shales, &c.	Calceola Kalk. Calceola Schiefer.	
	Eifelien or Schists & Limestones of Couvin. Coblenzien, Greywacke, & Red Schists. Gedinnien Arkose.	Hangman Grits and Lynton Beds. Foreland Grits.	Dartmouth Slates. Cockington Grits. Meadfoot Beds.	Green and Red Slates at Maker Fort. DarkGreySlates Looe Beds.	Upper Coblenz Stufe. Lower Coblenz Stufe. Siegener Greywacke.	Lower Devonian.

141. Ussher, W. A. E.—The Devonian Rocks of South Devon.

Q.J.G.S., vol. xlvi., p. 487, with two maps.

The rocks of South Devonshire, north of the Dart, and east of Dartmoor, are so broken, crushed, and inverted that stratigraphical evidence is not available, and opposite opinions have been formulated by the same author. All that can be done is to recognise the divisions as containing fossils known in Belgium to belong to the Upper, Middle, or Lower Devonian, and by limited sections to see some few of their relations together.

The Culm measures are only seen in natural junction with the Devonian near Chudleigh, and here they seem to be unconformable. The divisions recognised are as follows :—

Upper Devonian	Cypridinen Schiefer. (Entomis Shales.) Goniatite Limestones and Slates. Massive Limestones.
Middle Devonian	Middle Devonian Limestones. Ashprington Volcanic Series. Eifelian Slates and Shaly Limestones.
Lower Devonian	Lincombe and Warberry Beds, and Cockington Sandstones. Meadfoot Beds.

The Upper Devonian is specially characterised by slates of red and pale green tints; very unfossiliferous. The Middle by grey and bluish slates, with fossils in lenticles. The Lower by grits and sandstones, often in mass. The two former have, in common, massive limestones, and a local prevalence of volcanic tuffs; the two latter have slates of similar lithological character.

The Lower Devonian is developed near Torquay and round Paignton. In the former locality it is divisible into Lincombe and Warberry beds above, and Meadsfoot beds below. The fossils recognised from the former at Warberry Hill, Oxlea Hill, New Cut, Kilmorey and Smugglers' Cove are:—

Homalonotus champernowni.	Avicula anisota.
Spirifer cultrijugatus.	Pleurodictyum problematicum.
Chonetes sordida.	Beyrichia Wilckensiana.
Leptæna laticosta.	

From the latter, near Kilmorey, and Hope's Cove and Nose:—

Homalonotus? champernowni.	Spirifer speciosus?
Chonetes sarcinulata.	Strophomena (near) Murchisoni.
Rhynchonella daleidensis.	——— rhomboidalis.
Spirifer hystericus.	Pterinæa costata.
——— paradoxus.	——— spinosa.
——— undiferus.	Zaphrentis oolithica.
——— macropterus.	Pleurodictyum problematicum.

There is another patch near Kingsteignton which may belong here.

In the Paignton area, at Saltern, Goodington, Maildon, and Chinscombe, the upper part has yielded:—

Orthis hipparionyx.	Chonetes sordida.
Spirifer speciosus.	Rhynchonella Pengellyana.
——— lævicosta.	Leptæna looiensis.
Chonetes Hardrensis.	Pleurodictyum problematicum.

In the Cockington Grits, at Cockington, Shortdown, Chinscombe, Beacon Hill, and Stoke Gabriel:—

Homalonotus gigas.	Rhynchonella daleidensis.
Spirifer hystericus.	Leptæna spathulata?
Chonetes sarcinulata.	Nucula cf. Kahlebergensis.
——— semiradiata.	Pleurodictyum problematicum.
Rhynchonella hexatoma.	

The Eifelian slates have thin lenticular limestones intercalated. Those at Hope's Nose, Daddyhole Cove, Torquay Cemetery, Weston Bells, Bridgetown, and Highland Totness, Chenston, and elsewhere, have yielded:—

Atrypa reticularis.	Cyrtina Whidbornei.
——— aspera.	Calceola sandalina.
——— desquamata	Phacops latifrons.
Streptorhynchus crenistira.	——— batrachius.
——— umbraculum.	Scoliostoma texatum.

Rhynchonella procuboides.	Retepora repisteria.
Leptæna interstrialis.	Heliolites porosus.
Pentamerus galeatus.	Monticulipora cf. fibrosa.
Kayseria lens.	Helianthaster filiciformis.
Strophomena rhomboidalis.	Cyathophyllum heterophyllum.
Spirifer speciosus.	——— damnoniense.
——— curvatus.	——— helianthoides.
Orthis striatula.	Cystiphyllum vesiculosum.
——— near eifelensis.	Favosites Goldfussii.
Productus subaculeatus.	Stromatopora concentrica.

The Middle Devonian limestones occur in numerous localities, and their fossils have been mostly noted already—as at Marldon, West Ogwell, Ipplepen, and Dartington, *Stringocephalus* being the characteristic fossil. The limestones of Woolborough, Lummaton, Lang's Copse, and Balleigh Copse are on the border between Middle and Upper Devonian.

The following Stromatoporoids occur in these limestones:—

Stromatopora Hupschii.	Actinostroma clathratum.
——— buchaliensis.	——— verrucosum.
Actinostroma hebbomense.	

The Ashprington Volcanic series have Eifelian limestones near their base, and included slates at Gerston Cross and Endsleigh. The volcanic activity commenced, therefore, in the latter part of the Eifelian times, and not before; but volcanic products continue through the Upper Devonian.

The Upper Devonian Massive Limestones are not clearly separable from the Middle Devonian. At Petitor, Lower Dunscombe, Ideford, Whiteway Farm, Buckly Wood, Ramsleigh, and Daggers Mellons Copse they have yielded

Rhynchonella cuboides.	Camarophoria formosa.
——— acuminata.	Merista plebeia.
——— cf. parallipipeda.	Waldheimia Whidbornei.
Atrypa reticularis.	Goldius granulatus.
Athyris concentrica.	Nucleospira lens.
Spirifer bifidus.	Cyathophyllum hexagonum.
——— lineatus.	Stromatopora Hupschii.
——— ? urei.	Actinostroma clathratum ?
Productus subaculeatus.	

The Goniatite Limestones of Saltern Cove are found also at Silver Cove, Galmpton Point, Lower Dunscombe. The red slates of Petitor, the grey slates near Combe Cellars, with lenticles of limestone representing the "Knollen Kalk," and the similar rocks at Whiteway Farm, and Oldchard Well, 2¾ miles W. of Newton, and near Metley, yield a similar fauna. The following are recorded:—

Goniatites multilobatus.	Clymenia annulata.
——— intumesceus.	Rhynchonella cuboides.
——— acutus.	Cardiola retrostriata.
——— simplex.	Sanguinolaria elliptica ?
——— complanatus.	Heliolites porosus.
Clymenia lævigata.	

The Entomis slates occur on the banks of the Teign, near Kingsteignton, Knowles Hill, Whiteway Farm, and are characterised by the following:—

Posidonomya venusta.	Entomis serratostriata.
Trimerocephalus cryptophthalmus.	——— Sandbergi.
	——— gyrata.

142. Ussher, W. A. E.—The Triassic Rocks of West Somerset, and the Devonian Rocks on their Borders.

Proc. Som. Arch. N. H. Soc., N. S., vol. xv., p. 14. Pt. II., with a coloured geological map.

He gives the following table of correlations of the rocks of North and South Devon, from his excursions with the members of the Geological Congress:—

N. Devon and W. Somerset.	*S. Devon.*	
Pilton Beds.	Red and Grey Slates.	Upper.
Baggy Beds.	Slates with Calcareous nodules and *Clymenia*.	
Pickwell Down Grits and Slates	Limestone (local) Slates and Mudstones Limestone.	
Morte Slates.		Middle.
Ilfracombe Slates.	Limestone locally replaced by Slate and Volcanics.	
Basement part of Ilfracombe Slates.	Thin Limestone. Grey Slates.	
Hangman Grits.	Cockington, Lincombe, and Warberry Grits.	Lower.
Lynton Beds.	Meadfoot Slates.	
Foreland Grits.	? Dartmouth Slates.	

In West Somerset are Foreland Grits, reddish quartzose grits, the Lynton beds, uneven grey slates and grey grits, and Hangman grits, coarse and quartzose, the Morte and Ilfracombe Slates, not here so distinct as in the typical localities, and the Pickwell Down Beds.

The Quantock Hills are made of rocks of the Hangman grit series and the flanks of Middle Devonian. Limestones occur in various places by means of faults, as in the Brendon and Dunkery Ranges. He finally discusses the question as to whether the Foreland Grits may not be the Hangman Grits brought where they are by faults, and gives many reasons on either side, but decides that they are different both lithologically and also palæontologically, on account of the barrenness of the former.

[**143.**] **Ussher, W. A. E.**—The Devonian Rocks as described by De la Beche, Interpreted in Accordance with Recent Researches.

Paper read to the British Association on September 5th, and also to the Royal Geological Society of Cornwall in November, but not published in 1890.

144. Williams, H. S.—The Devonian System of North and South Devonshire.

"American Journal of Science." Third Series. Vol. xxxix., p. 31.

Also Proc. Am. Ass. Adv. Science. Thirty-eighth Session. P. 233.

The species he observed in our collections are very closely allied to the species in the New York Devonian, though different names are assigned, but the rocks are entirely different. He considers the stratigraphy to give no clear indications of the sequence, even in North Devon, as he had expected. "There appears to be no well-defined Lower Devonian fauna for England, nor any uniform character of deposits to represent it." It is probable that different species of fossils lived during the period side by side, so that limestones of the same age need not have the same fauna. The limestones of South Devonshire probably represent the general interval between the Chemung and Corniferous formations. The "cuboides" fauna had a centre of distribution nearer North France than East America, and hence reached the former country at an earlier period, *e.g.*, *Spirifera disjuncta* is, in England, a Middle and Upper Devonian form, but in New York only an Upper. Our Upper Devonian fauna is represented by the Chemung, with rather a Carboniferous aspect. The marine faunas of the Devonian had different histories in the two areas. Those of England are merely successive stages of the life inhabitants of a common and more or less continuous basin. The Appalachian basin was bounded on the east by a considerable barrier, and partially separated from the central continental basin. With the Tully Limestone an incursion of species of the European fauna began, so that the Chemung above resembles the European Upper Devonian. They probably came by a channel from the north and east, and did not reach the central basin.

145. Hicks, H.—On the Rocks of North Devon.

Abstract in Proc. Geol. Soc. 1890-1. P. 7.

The author believes that the Morte slates are the oldest beds in the district, and that they have been brought into a conformable position, apparently overlying much newer beds [Ilfracombe slates ?] by a thrust. No evidence for this thrust is given in the abstract, and, according to the discussion, none was given in the paper. These slates contain a *Lingula* which is "certainly not a Devonian species, but evidently a much older form" [but it is not named]. According to this, the beds on the north and south are more or less equivalent, and, taking the Brachiopoda alone, 13 out of 20 are common, and 4 others are Middle Devonian forms.

In the discussion, it was stated that the other fossils are characteristically distinct, and that the adoption of the author's views would introduce confusion elsewhere in regions which the paper gave no evidence that he had considered.

OLD RED SANDSTONE.

146. Piper, G. H.—On the Passage Beds of the Old Red Sandstone at Ledbury.

Trans. Woolhope Nat. F. C. for 1883 (published in 1890), p. 136; with a plate.

Gives some details of the tunnel entrance section. He has found perfect specimens of *Auchenaspis* and a new species of *Cephalaspis* in some of the beds, and has found the Ludlow Bone Bed here. The following is the section summarised from 29 beds:—

Sandstone and marls	347 ft.
Ledbury grits, with *Auchenaspis*, &c.	6 „
Shales, with new *Cephalaspis*	64 „
Bluestone, with a trilobite	3 „
Marls and grits and sandstones	74 „
Brownish greystone, with perfect *Auchenaspis Egertonii*, new *Cephalaspis*, &c.	1 „
Shales and sandstones	8 „
Fine grained Red Sandstone, with *Auchenaspis*, *Cephalaspis*, &c.	4 „
Various shales, &c.	236 „
Downton sandstone	8 „
Upper Ludlow shales	140 „
Aymestry Limestone, with a one-inch *Pentamerus* bed	236 „
Transition beds	12 „
	1,139 ft.

147. Piper, G. H.—On the Old Red Sandstone, as seen from the Sugar Loaf Mountain, Monmouth.

Trans. Woolhope Nat. F. C. for 1885 (published in 1890), p. 313.

A general description.

148. Evans, J. W.—The Old Red Sandstone of Lake Orcadie.

Proc. London Amateur Scientific Society, vol. i., p. 25.

He has traced the Old Red coast line from Moray Firth to Strathie Point. At Ousedale basement conglomerates commence the series, followed by 8,000 feet of sandstones and conglomerates, to a synclinal at Latherton. These are followed by 9,000 feet in a downward succession to Scarlet; thence from an anticlinal we pass upwards for 6,000 feet.

These are all considered equivalent. From Sinclair Bay to Duncansby Head are red and yellow sandstones and grey flags. Along the North Coast we pass down through 8,000 feet to an anticlinal at Ham. The beds are more fissile and calcareous. Hence, to Strathie point, we pass up through 6,000 feet, the strata assuming a more littoral facies. All these he considers contemporaneous, and argues that the northern series are not proved by Dr. Geikie to be the younger. The only two fishes of the east absent from the north are *Dipterus Valenciennesii*, which occurs in their Orkney extension, and *Osteolepis arenatus*, which does not really differ from the northern *O. macrolepidotus*. The absence of northern fishes in the eastern beds is accidental. The difference in lithological character is merely due to there being less littoral deposits. To change from one to the other by superposition would require a very enormous fault.

149. Barclay, R.—The Geology of the Highlands from Mount Battock, Kincardineshire, to the Village of Edgell, and thence to the Sea at St. Cyrus.

"Scottish Naturalist," No. 30, p. 347.

After the transition slates, we pass over 800 yards of vertical brown quartzite, then 400 yards of the great conglomerate, and then ancient red sandstone (vertical), but changing to horizontal. After this comes ferruginous shale in the valley of Mearns, then hard red rock, and then a few feet of grey slate, and nearer Montrose is the quartzite of White Craig Quarry, and above this a dark fucoid grey slate with a fossil the writer called in 1856 *Kampecaris forfarensis* (Brit. Ass. Rep.). [He disbelieves the Caledonian Lake theory of the Old Red Sandstone.]

[**150.**] **Mitchell, H.**—The Old Red Sandstone of the Montrose District.

Paper read to the East of Scotland Union on July 23, but not published in 1890?

CARBONIFEROUS.

151. Mayow, R. W.—A Lump of Coal.

"The Rochester Naturalist," No. 28, p. 457; No. 29, p. 480.

A popular article.

152. Hull, E.—On the Probably Average Depth at which Coal is now being Worked in the British Isles.

Trans. Manch. Geol. Soc., vol. xx., p. 417.

From information received from J. T. Boot, of Mansfield, he states that in the counties of York, Derby, and Notts,

the following are the depths at which coal is now worked:—

Depths in Yards.	No. of Collieries.	Depths in Yards.	No. of Collieries.
0— 50	8	300—350	8
50—100	14	350—400	2
100—150	31	400—450	2
150—200	21	450—500	5
200—250	14	500—550	4
250—300	10	650—700	1

As the output from the deeper pits may be reckoned as twice that from the shallower ones, and those less than 150 yards in depth may be neglected as out of work, the average depth may be put at 250 yards; but in the Lancashire coal field it is greater, and he thinks it is more like 350 yards. A long discussion followed this paper, dealing rather with the possible, than with the actual, depth of working.

153. Bulman, G. W.—On a Coal Seam in the Bernician Series of Northumberland, and its Bearing on the Theory of the Formation of Coal.

"The Naturalist," p. 321.

One of the Bradnell coals has its underclay, and is immediately overlain by a limestone, and in another section a clayey band with carbonaceous matter is likewise overlain by limestone. He accordingly concludes that this coal must have been formed at sea [if the limestone is marine by its fossils, the coal must be a drift coal]. If so, the underclay is not necessarily evidence of growth *in situ*, nor always a terrestrial accumulation [he does not say why it is called an underclay, *i.e.*, whether it contains rooflets or is irregular].

154. Harker, A.—The Basement Carboniferous Conglomerate at Ulleswater.

The "Naturalist," p. 202.

At Dunmallet, by the lake side, the pebbles are large, and are seen to be of Coniston Grit, the volcanic series of Borrodale and Coniston Limestone.

155. Dakyns, J. R.—The Geology of the Country around Ingleborough.

Memoirs Geol. Survey, chapters iii., v., vi., vii.

Strahan, A.

Ibid, chapter iv.

Tiddeman, R. H.

Ibid, chapter viii. The Ingleton Coalfield.

The beds below the Coal Measures are here classified as follows:—

MILLSTONE GRIT—

Sandstone of Brickden Pike	70 feet.
Shale	50 ,,
Sandstone of Whernside Top	50 ,,
Shale	50 ,,
Sandstone of Widdale Fell	60—90 ,,
Sandstones and Shale	100—184 ,,
Pebbly Grit of Ingleborough	50—140 ,,

YOREDALE BEDS—

Shales	120 feet.
Main Limestone	50—60 „
Sandstone and Shales	330 „
Limestone with Shale (Underset)	8—10 „
Shale and Sandstone..	60 „
Middle Limestone	15—20 „
Sandstone and Shale..	150 „
Simonstone Limestone	25—30 „
Sandstone and Shale..	100 „
Hardraw Scar Limestone	30—40 „
Shales and Limestone	30 „

CARBONIFEROUS LIMESTONE—

Great Scar	600 „

BASEMENT BEDS—Impersistent.

[The above is a combination of three sections given.]

Ingleborough District.—The Carboniferous series lies unconformably on the Silurian; sometimes pure limestone succeeds, but in places there are red conglomerates, with quartz pebbles at the base, reaching in one case to 25 feet; sections of such are given at Gillet Brae Head, Ribblesdale, and Thornton Force. The Silurian rocks sometimes stand up in bosses below, as at Twisleton Dale House, and above Cattle Bank in Crummack Dale, and large masses of the underlying rock lie as fragments in the basement beds.

The Great Scar Limestone rises to its highest point, 1,500 feet above the sea, on Ingleborough, and terraces of it are well shown in Chapel-le-dale, and all over the surface it is fissured and weathered. The Hardraw Scar Limestone is seen on Simon Fell as a dark bituminous and cherty rock. The beds above are traceable east of this hill. The Underset Limestone is not seen at all on Ingleborough, having died out [yet a limestone is mentioned in the section in the proper position], but the main limestone forms the scar on the north side. A detailed section of the beds in Whernside is given, including a band of coal near the top, and showing the Underset Limestone in one place 7½ feet, in another 25 feet. In Gale Beck another section shows it 50 feet. Sections are also given at Far House Barn, Carn Beck; South of Old Ing; Buck Beck and Gaze Gill; Long Gill; Graygarth Fell, east side. On the south end of Whernside a section gives a total from the [base of the ?] Great Scar Limestone to the bottom of the Underset of 1,140 feet.

Dent and Garside.—The basement beds are only seen in Hole-Beck Gill, but the Great Scar Limestone is laid bare nearly the whole length of the Dent Valley. The Yoredale beds are well seen in the gills running northwards to Gawthorp. In Oliver Gill the Simonstone Limestone was worked

for black marble; at Dent Head the Hardraw Scar Limestone was worked; and on Crag Fell the Underset Limestone yields encrinital marble. One of the bands in Oliver Gill is full of corals, and on Widdale Fell the coal band has been worked. A section is given from Barkin Calf, in Silurian beds, across the Dent Fault to Crag Fell, where the Carboniferous is horizontal, though turned up on edge at the fault.

Littondale.—There is little special here. The dip of the beds is small, and may be entirely due to original deposition, as the lower beds thin in the same direction. The Main Limestone is possibly here split into two, by a series of fissile calcareous cherts seen at Darnbrook and Fountain Fells.

Wharfedale.—At Kettlewell, 775 ft. of Great Scar Limestone is seen, and is overlaid by 253 ft. only of Yoredale beds in a mine section, but by 407 ft. on Old Cote Moor. The upper part of the Great Scar Limestone is full of *Producti*. The remainder is of the description taken up by numerous detailed sections which are not compared, nor are any points of interest brought out.

Millstone Grit.—On Penygent, 203 ft. of shales and grits are seen above a thin bed of coal; below comes a pebbly grit (*A*) 78 ft., then shales 30 ft., and then another grit (*B*) 58 ft., and finally shale 9 ft. above the Main Limestone. The bed *A* is the same as that which caps Ingleborough, and is taken as the base of the Millstone Grit; the 97 ft. below are classed with the Yoredales; on Whernside, these latter are only 56 ft. The grit *B* is probably the equivalent of the 10 fathom grit of Swaledale. The coals are only dug out occasionally for burning lime.

The Coal-field of Ingleton and Black Burton.—This is limited to the west of Burton by the Millstone Grit, on the east by the Craven fault; on the south the beds crop out, but the extent on the north is unknown. Coal Measures, of a red colour, are, however, seen in Leck Beck, which were formerly, without reason, taken for Old Red Sandstone. Between the two bridges at Ingleton are beds of gypsum and dolomitized limestone, not known elsewhere in the neighbouring Coal Measures, but they may belong to the upper part of the series, as similar rocks do near Manchester. A section of the Newfield pits is given, showing 114 ft. of beds below the drift to the 6 ft. coal, the main coal lying 85 ft. above it. A section, showing 146 ft. of strata, with a 1 ft. coal, may be seen in a gill near Yarlsber. At the base there is a "soapstone," met with also in Moorgarth Colliery.

156. Hardcastle, C. D.—The Physical Features of Ingleton.

Proc. Leeds Geol. Assoc., p. 16.

A general sketch of the geology of the district, dealing chiefly with Carboniferous beds, and following closely the lines of the Geological Survey Memoirs.

157. Russell, R.—The Geology of the Southern Portion of the Yorkshire Coal-field.

Proc. Midland Inst. of Min., Civil, and Mech. Eng., p. 41.

This paper, though containing probably nothing that is absolutely new, gives a very clear account of the succession of strata in this district. Commencing at the base in the Lower Coal Measures, we have first :—

Thin Coal and Underclay.—The coals are worthless, but the fireclays are very refractory. The series is very constant, and is worked as far as Huddersfield. The strata above contain a sandstone called the Crawshaw Sandstone. It is there 150 ft. thick; about Longsett it dies out, but again reaches a thickness of 110 ft. near Huddersfield.

Coking or Soft Bed Coal.—This is always between 1 and 2 feet thick. It is the most regular and continuous in the whole district. It is much sought after for making smithy coke, especially near Sheffield.

Strata between the Coking Coal and the Ganister Coal.—These constitute a stratigraphical zone of a most distinct character. It contains a thin band called the Clay Coal, and is about 150 ft. thick. The thick sandstone below the Clay Coal is known as Middle Rock. This is thickest north of Sheffield to Oughterbridge, but continues to Huddersfield. The Clay Coal is worked for its ganister and underclay. Near Deep Car Mill, the series changes character, being much thinner. Sections are given at Midhopestones, New Mill, and Mold Green, all of the ordinary type.

Ganister Coal.—This has no ganister below at the extreme south, but it soon comes on. Both are pretty uniform on either side of 2 ft. The coal is chiefly used for engine purposes, and occasionally as a household coal. The ganister is unrivalled for its refractory qualities. Occasionally, there are balls of iron pyrites and carbonaceous fossiliferous nodules called "Bullions" in the roof. The group of strata between this coal and the Brincliffe Edge Rock contains several important sandstones, but they are not continuous. One of these is called the "Loxley Edge Rock" (40 ft.), another "Wharncliffe Rock" (70 ft.). The former increases at Crookes Moor to 150 ft., and is very coarse at Loxley. The Wharncliffe rock is conspicuous in the south, then dies out, but increases again to 100 ft. in Wharncliffe crags, and then dies away again.

Brincliffe Edge Rock, Greenmoor Rock, or Elland Flagstone.—South of the Sheaf this is divided by shale bands, but becomes a solid mass of 105 ft. on Brincliffe Edge, and near

Sheffield. Northwards to Wharncliffe Moor, it becomes so feeble it may even disappear. It comes in again at Wortley, and makes a good freestone at Green Moor. At Brock Holes it begins to be split up, and is in thin bands or flags near Huddersfield.

Strata between the Brincliffe Edge Rock and the Silkstone Coal.—This group is irregular, and may be divided into a northern and southern type, the change taking place near Huddersfield. The latter type is distinguished by massive sandstones and an important coal. A particular sandstone is called the Grenoside Rock, and between this and the Brincliffe Edge Rock lie the Low Moor, Black, and Better Bed Coals. In the extreme south, the Better Bed Coal cannot be traced; its place is taken by fireclay and ironstone in various sections given. About Rowley and Highburton the coal sets in and becomes workable.

The Grenoside Rock assumes a conspicuous form north of Sheffield, at Grenoside, east of Wharncliffe to Pickelow Hill, but is lost east and north of Huddersfield. It is a thick-bedded rough grit.

Penistone Flags are in two or three beds only, welldeveloped where named, where a section is given showing them interbedded with thin coal.

Whinmoor Coal is difficult to trace near Sheffield, though apparently once worked. At Wharncliffe and in Deffer Wood it is sunk to, and as far as Shelley. It reaches 3 ft.

Silkstone Coal.—The Black Shale Coal of Derbyshire is known by this name near Sheffield, between which town and Cawthorne it is very uniform in thickness and quality. It consists of two parts, an upper, 1 ft. to 3 ft., and a lower, 1 ft. 9 in. to 3 ft. 7 in., with a shale parting. Towards Cawthorne, this shale thickens, and the coals split up and are lost. Sections are given at Woodthorpe, Hoyland, Barrow, Stanhope, Cawthorne, and Falconer collieries, to show its changes. Further north, about Emly and Flockton, a series of coals sets in on the same horizon.

The series following are referred to the Middle Coal Measures.

Claywood Ironstone and Silkstone Rock.—The ironstone is 12—14 yards above the Silkstone Coal, and consists of layers and nodules, in a thickness of 1 ft. 8 in., and is worked round Chapel Town. The sandstone lies almost immediately above, and is 90 ft. thick. Above it come the Silkstone Four-foot, the Swilley, and Thorncliffe thin coals.

Park Gate Coal consists of several bands, in the midst of which is a band of semi-anthracite known as the "Hards" 2 ft. 6 in. to 3 ft. thick. It is well developed from Sheffield to Cawthorne, but then splits up, the "old Hards" begin-

ning again near Emly. The succeeding strata, containing the Park Gate Rock, Fenton's Coal (a sample from Aldwarke yielded 1·37 ash, 0·95 sulphur, and 65·25 per cent. of coke), Blackmine Ironstone, Flockton Coal, and Tankersley Ironstone, have been described in a former paper under the name of the Flockton Group.

Swallow Wood Coal is most constant and regular throughout the district, though known by various names. It consists of a hard coal, 2 ft. to 3 ft. above, and a soft coal 1 ft. to 2 ft. 3 in. below. At Car House it contains 1·78 ash, 0·89 sulphur, and yields 61·39 per cent. of coke. The two parts keep together from Sheffield to Barnsley, but north of that town are separated by 10—11 yards of strata, and are then known as the Netherton Thick and Netherton Thin.

Barnsley Coal is divided into Top Softs, Hards, and Bottom Softs, and sections of the seam at Kiveton Park, Aldwarke, Elsecar, Monckton, Woolley Edge Tunnel, Denaby, Wombwell, Oaks, and Mapplewell collieries, show that, with minor variations, it is pretty constant in character from Sheffield to Barnsley. The Hards are especially valuable from containing bright and dark layers, or a combination of anthracitic and bituminous portions. The soft is a household coal. When the partings increase in thickness, as they do northwards, the coal loses its value. The total coal is 8—10 ft.

Strata between the Barnsley and Wathwood Coals.—South of Sheffield there are five seams of coal in this space. North of it, they have different names.

Wathwood Coal runs up to three feet, and is good, but is liable to be swamped when overlaid by the next sandstone.

Woollev Edge Rock appears suddenly on the north side of Elsecar Brook, and continues to Normanton and Pontefract. It is very coarse, and at Monk Bretton is 131 ft. thick, but is divided by shales in the Oaks Colliery, a section of which is given. Near Wakefield, it changes suddenly to fine-grained and flaggy, and it has the same character at Normanton.

Treeton or Oaks Rock is compact and massive at Treeton, but dies out rapidly north-west of Brinsworth. At Oaks Colliery it is divided by several bands of shale. From Kilnhurst to Barnsley it makes a good feature, and is here used for building. Northwards from Monk Bretton it is less conspicuous, and in its range it is three times replaced by shales, (1) at Holmes Colliery; (2) near Pontefract; (3) at Glasshoughton. It is often very full of water. The strata above are variable, and contain three coal seams.

Shafton or Nortel Coal.—This occurs on the eastern side from Denaby to Felkirk. It is sometimes five feet thick. A

section is given at Ellis Lake Colliery, where it is worked as an engine coal.

The Strata above the Shafton Coal are 1,100 ft. thick, and contain several sandstones and thin seams of coal. Some of the sandstones are very local, as the Thryberg Hall Rock, but the Herringthorpe coal is pretty continuous north of Rotherham.

The remaining series is classed as Upper Coal Measures; they are unconformable on those below.

The Red Rock of Rotherham was first considered the equivalent of the Woolley Edge Rock, and is so mapped. Then it was considered to be Permian. However, it contains Coal Measure plants and seams of coal, and at Masborough Station the overlying shales resemble Coal Measures. Nevertheless, the unconformity is well shown at Holmes Colliery, and from Treeton to Aston it may be seen at different levels above the Barnsley Coal, as also on comparison of the Kiveton Park Colliery and the Shireoaks. It does not extend north of the Don Valley.

158. Nevin, John.—On the Difference between the Seams in the Northern and Southern Parts of the Yorkshire Coal-field as shown in some of the Deeper Sinkings.

Proc. Mid. Inst. of Min., Civil, and Mech. Eng., Barnsley. Pl. i., ii., and iii.

This gives an account of the whole series of coals in north and south, as made out in successive collieries. In the north, the first important coal is the Scale Coal, 3 ft. at 310 yards; the Stanley Main, 8 ft. 6 in., with 6 ft. 2 in. of coal at 330 yards; the Warren House, 5 ft. 2 in., with 4 ft. 3 in. of coal at 412 yards; the Haigh Moor, 9 ft. 11 in., with 6 ft. 10 in. of coal at 505 yards (the second best); the Joan, 2 ft. at 608 yards; the Flockton Thick, 3 ft. at 627 yards; the Flockton Thin, 2 ft. 8 in. at 650 yards; the old hards, Greenlane and then the Middleton Main, 3 ft. 6 in. at 720 yards (the best); the Wheatley Lime, 2—3 ft. at 738 yards; the Blocking and Shirtcliffe, and then the Low Moor Black bed at 920 yards (a gas coal); the Low Moor Better bed, 1 ft. 6 in. at 960 yards, only locally of value. Below this come the Elland Flags, &c., down to 1,200 yards, but there are no workings.

In the south is the Shafton Coal, 3 ft. at 185 yards; the Sharlston, Crofton Top, and Crofton Low, between 255 yards and 314 yards, each about 3 ft.; the Woodmoor, 3 ft. at 480 yards; the Kent Thin, 3 ft. at 525 yards; the Barnsley Coal, 9 ft. 8 in. at 630 yards; the Swallow Wood, 3 ft. at 690 yards; the Ledget, 3 ft. at 760 yards; the Flockton Thick, 3 ft. at 832 yards; the Flockton Thin, 3 ft. at 860 yards; the Fenton at 895 yards; and then the Parkgate with 4 ft. 6 in. of good coal (the third best); the Thorncliffe Thin, 4 ft. 6 in. at 950

yards; and then the Silkstone, 5 ft. 2 in. at 1,010 yards (the best); and finally, the Whinmoor, 3 ft. at 1,075 yards. Of these, the Flockton and Whinmoor are continuous; the others it is impossible to correlate, though the total thickness of coal and measures is nearly the same. The Middleton Main is worked south to a certain boundary, and the Silkstone to a northern boundary, and these do not overlap.

[**159.**] **Dakyns, J. R.**—On the Changes of the Lower Carboniferous Rocks in Yorkshire, from South to North.

Paper read to the British Association on Sept. 5, but not published in 1890.

[**160.**] **Holgate, B.**—The Carboniferous Strata of Leeds and its immediate Suburbs.

[**161.**] ————.—Paper on some Physical Properties of the Coals of the Leeds District.

Papers read to the British Association on Sept. 4, but not published in 1890.

[**162.**] **Steel, R. E.**—The Millstone Grits.

Paper read to the Bradford Naturalists and Microscopists' Society on May 5, but not published in 1890.

163. Tiddeman, R. H.—On Concurrent Faulting and Deposit in Carboniferous Times in Craven, Yorkshire, with a Note on Carboniferous Reefs.

Rep. Brit. Ass. for 1889, p. 600.

The Craven faults are complex, consisting of three principal branching ones. The rocks of the district show some peculiar features.

1. There are two distinct series, differing much from each other in thickness and grouping.
2. These two series have the chief Craven faults as their common boundary.
3. The series north of the Craven fault, which may be called the Yoredale type, extends over a wide area to the north; and the south, or Clitheroe and Bowland type, over an equally wide area to the south.
4. In the neighbourhood of the faults there is very little transition from one type to the other.
5. The greater thicknesses are on the downthrow side of the faults.

The Coal Measures and Millstone Grits cannot be compared, but 400—900 ft. of the Yoredale series on the north, with many bands of Limestone, corresponds to 300—1,250 ft. of Bowland Shales and Pendleside Grits, with scarcely any limestone; and 400—800 ft. of Carboniferous Limestone corresponds to 0—400 ft. of Pendleside Limestone, 2,500 ft. of Shale with Limestone, and 3,250 ft. of Clitheroe Limestone, or more than 5,400 ft. in all. The conclusion is, that faulting must have

gone on simultaneously with deposit [but this alone will not account for the occurrence of the two types side by side].

He calls attention to remarkable mounds of limestone, made up of fairly perfect remains of a variety of organisms, and resting *in situ* on the Pendleside Limestone. They often have *débris* at their base, and they are covered up by the Bowland mud. He calls these "knoll reefs," and considers they have been built up in the same way by other forms of life, as coral reefs have by corals.

164. Ward, J.—The Geological Features of the North Staffordshire Coal Fields; their Organic Remains, their Range and Distribution; with a Catalogue of the Fossils of the Carboniferous System of North Staffordshire.

Trans. N. Staffordshire Inst. Min. and Mech. Eng., vol. x., p. 190; with 7 Plates.

This paper is not confined to new observations, but contains a general account of all that has hitherto been ascertained on the subject.

On the Carboniferous Limestone, reference is made to the description by T. Wardle, in Sleigh's "History of Leek," and the list of fossils on p. 95 is from the same source.

The classification and fossil contents of the Yoredale series is taken from the Memoirs of the Geol. Survey. At Dane Bridge, the following fossils are recorded:—

Goniatites Listeri.	Posidonia Gibsoni.
———— bilinguis.	Aviculopecten papyraceus.

The Millstone Grit is only 200 to 300 ft. thick, only the first grit, or "Rough Rock," and the third grit being represented.

The two principal faults on the northern and western margins of the Pottery Coal-field are known as the "anticlinal" and the "Red Rock" faults.

There are four coal-fields in N. Staffordshire, known as the "Pottery," the "Wetley and Shafferlong," the "Goldsitch Moss," and the "Cheadle and Churnet Valley."

The Pottery coal-field is in the form of a triangle, the apex lying in the deep synclinal curve, known as the Biddulph Trough. The series here shown is divided as follows:—

1. Upper Division—Red and purple marls with thin coal seams, three or four bands of Blackband Ironstone and *Spirorbis* Limestone at the base.
2. Middle Division—with valuable ironstones and coals for manufacturing purposes.
3. Lower Thick Division in two parts. The Upper, containing the principal household coals, and others free from sulphur, with marine bands; the Lower, of dark shales with purple grits and conglomerates, and four or five thin coals.

The total thickness is about 3,950 ft. A general outline is then given of the distribution of the different classes and families of organic remains—which is repeated more at length in subsequent pages. He then proceeds to give complete lists of the fossils known to him from the various beds.

From the Yoredale Grit are recorded (omitting unnamed species) :—

Goniatites excavatus.	Goniatites striatus.
——— obtusus.	——— truncatus.
——— reticulatus.	

From beds below the Yoredale Grit :—

Aviculopecten papyraceus.	Discina nitida.
——— ultimatus.	Productus longispinus.
——— fibrillosus.	——— semireticulatus.
Ctenodonta gibbosa.	Streptorhynchus crenistria.
Chonetes tuberculata.	Stigmaria ficoides.

From the Millstone Grit :—

Calamites Suckovii.	Lepidodendron aculeatum.
——— varians.	——— obovatum.
Mariopteris muricata.	Stigmaria ficoides.

In the Lower division of the Lower series are found :—

In the Cockhead Ironstone—

Acanthodes Wardi.	Gyracanthus formosus.
Cheirodus granulosus.	Sphenacanthus hybodoides.
Megalichthys Hibberti.	Ctenodus cristatus.
——— coccolepis.	Anthracosia acuta.
Cœlacanthus lepturus.	——— ovalis.
Mesolepis scalaris.	——— lateralis.
Helodus simplex.	Beyrichia arcuata.
Pleuroplax Rankini.	Spirorbis carbonarius.

From above the Hard Mine Coal—

Anthracomya modiolaris.	Anthracoptera triangularis.
Anthracoptera quadrata.	Anthracosia acuta.
——— carinata.	Belinurus trilobitoides.

From the "Mussel Bed" above the Ten-foot Coal—

Anthracosia aquilina.	Anthracosia ovalis.
——— subconstricta.	Anthracoptera Browniana.
——— robusta.	Anthracomya Phillipsii.

From a bed of sandstone below the New Mine Coal—

Calamites Suckovii.	Sigillaria major.
Lepidodendron aculeatum.	——— tessellata.
Cordaites borassifolius.	Stigmaria ficoides.
Dactylotheca plumosa.	

In association with the Bowling Alley coal is a bed of petroleum shale, and in the sandstone above are :—

Calamites cistii.	Rhacophyllum crispum.
Calamocladodus equisetiformis.	Neuropteris heterophylla.
Lepidodendron obovatum.	——— gigantea.
Alethopteris lonchitica.	Cordaites borassifolius.

From the Holly Lane Coal—

Anthracosia robusta.
——— ovalis.
Anthracoptera robusta.

From above the Moss Coal:—

Anthracosia lateralis.
——— ovalis.
——— subconstricta.
Anthracosia acuta.
——— robusta.

In the strata above the Gin Mine Coal, found in sinking a shaft at Speedwell Colliery, Longton, are marine fossils:—

Goniatites excavatus.
——— striatus.
——— multilobus.
Discites subsulcatus.
Euomphalus tuberculatus.
Macrocheilus Michotianus.
Bellerophon Dumontii.
Cypricardia glabrata.
Solemya primæva.
Nucula gibbosa.
——— lineata.
Leda clavata.
Chonetes Laguessiana.
Spirifera Urei.
Productus semireticulatus.

These are small in size, and are distributed in zones. The Little Mine Ironstone contains *Anthracomya Adamsii.* In and about the Ash coal are found:—

Rhadinichthys Wardi.
——— Planti.
Cœlacanthus lepturus.
Rhizodopsis sauroides.
Helodus simplex.
Gyracanthus formosus.
Diplodus gibbosus.
Anthracosaurus Russellii.
Keraterpeton Galvani.*
Anthracoptera Browniana.

In the Middle Coal Measures, the fish remains are much more numerous and better preserved. The Knowles Ironstone is very rich, especially the clay-ironstone nodules. It contains:—

Platysomus parvulus.
Cheirodus granulosus.
Mesolepis Wardi.
——— scalaris.
Helodus simplex.
Elonichthys oblongus.
——— caudalis.
——— semistriatus.
——— microlepidotus.
Cœlacanthus lepturus.
Acanthodes Wardi.
Ctenodus cristatus.
——— oblongus.
——— imbricatus.
——— ellipticus.
——— tuberculatus.
Ctenoptychius apicalis.
Callopristodus pectinatus.
Pleuroplax affinis.
Gyracanthus formosus.
——— tuberculatus.
Sphenacanthus hybodoides.
Orthacanthus cylindricus.
Megalichthys Hibberti.
Rhizodopsis sauroides.
Strepsodus sauroides.
Pleuracanthus alatus.
——— lævissimus.
Diplodus gibbosus.
Acanthoptera Browniana.
Anthracosia acuta.
Anthracomya Adamsii.
——— subconstricta.
——— pumila.
Carbonia fabulina.
——— Rankiniana.
——— pungens.
——— bairdioides.

From the Knowles Rock, 30—40 ft. higher, come:—

Alethopteris lonchitica.
Dictyopteris Munsteri.
Mariopteris muricata.
Calamites varians.
Lepidodendron obovatum.
——— serpentigerum.
Sigillaria major.
Stigmaria ficoides.

[* This is called *Urycordalis* (sic) *Wandesfordii*, but on page 187 the other name is given.]

In the Priorsfield Ironstone at Longton, are found :—

Lingula mytiloides.
Discina nitida.

These are 420 ft. above the last marine band; and at 80 ft. higher, over the Bay Coal, are found *Spirifer*, *Productus*, and :—

Discina nitida.
Lingula squamiformis.
——— mytiloides.
Aviculopecten papyraceus.
Nautilus falcatus.
Mariopteris muricata.
Sphenophyllum cuneifolium.

In the Rag Mine Ironstone at Longton and Fenton occur :—

Anthracosaurus Russellii.
Cheirodus granulosus.
Platysomus parvulus.
Cœlacanthus lepturus.
Megalichthys Hibberti.
Rhizodopsis sauroides.
Strepsodus sauroides.
Ctenodus cristatus.
Gyracanthus formosus.
Sphenacanthus hybodoides.
Helodus simplex.
Callopristodus pectinatus.
Ctenoptychius apicalis.
——— denticulata.
Pleuracanthus levissimus.
——— gibbosus.
Orthacanthus cylindricus.
Anthracosia subconstricta
Lepidodendron obovatum
Stigmaria ficoides.
Ulodendron minus.

From the Chalky Mine Ironstone :—

Loxomma Allmanni.
Platysomus parvulus.
Cœlacanthus lepturus.
Rhizodopsis sauroides.
Strepsodus sauroides.
Megalichthys Hibberti.
Acanthodes Wardi.
Ctenodus cristatus.
Ctenacanthus hybodoides.
Gyracanthus formosus.
Helodus simplex.
Orthacanthus cylindricus.
Anthracomya Phillipsii.

In the Rusty Mine Ironstone occurs *Spirorbis carbonarius*.

From the Gold Mine Ironstone at Silverdale, probably the equivalent of the Knowles Ironstone, are obtained :—

Rhizodopsis sauroides.
Strepsodus sauroides.
Megalichthys Hibberti.
Cœlacanthus lepturus.
Ctenoptychius apicalis.
Diplodus gibbosus.
Anthracomya Phillipsii.

The Brown Mine Ironstone is probably the equivalent of the Rag Mine, and contains *Platysomus parvulus*.

The Deep Mine Ironstone is divided into four 2 ft. bands. The intervening shales yield :—

Cheirodus granulosus.
Cycloptychius carbonarius.
Gonatodus Molyneuxi.
Rhadinichthys Planti.
Elonichthys Egertoni.
Cœlacanthus lepturus.
Megalichthys Hibberti.
Rhizodopsis sauroides.
Strepsodus sauroides.
Acanthodes Wardi.
Gyracanthus formosus.
Helodus simplex.
Callopristodus pectinatus.
Ctenoptychius apicalis.
Janassa linguiformis.
Pleuracanthus gibbosus.
——— alatus.
——— robustus.
Orthacanthus cylindricus.

In the Pennystone Ironstone fossils are rare, the commonest being :—

Megalichthys Hibberti.	Ctenoptychius apicalis.

The roof shale of the Cannel Mine has yielded :—

Diplodus gibbosus.	Spirorbis carbonarius.
Ctenoptychius apicalis.	

In the Gubbin Ironstone are found :—

Pteroplax cornuta.	Megalichthys Hibberti.

the former being in the highest horizon on which Amphibians are here found.

Above this comes a great thickness of strata with the Great Row and other coals and important fire-clays. In the Great Row Rock occur :—

Alethopteris lonchitica.	Lepidodendron Sternbergii.
Mariopteris muricata.	——— aculeatum.
——— nervosa.	Sigillaria tessellata.
Neuropteris rarinervis.	Stigmaria ficoides.
——— heterophylla.	Calamites approximatus.
——— gigantea.	——— ramosus.
——— plicata.	Calamocladus equisetiformis.
——— Scheuchzeri	Sphenophyllum cuneifolium.
Sphenopteris grandifrons.	——— saxifragæfolium.

A large number of fossil trees have been found in the Marl Pit, Joiner's Square, Hanley, standing perpendicular to the stratum. The surrounding shales contain abundance of Lycopod spores.

The Brassey Mine Ironstone is black and laminated; it contains :—

Ctenodus cristatus	Anthracomya Phillipsii.
Megalichthys Hibberti.	Spirorbis carbonarius.
Cœlacanthus lepturus.	Stigmaria ficoides.
Diplodus gibbosus.	

The Upper Coal Measures contain but few fossils. A mineral railway cutting between Longton and Trentham, in strata about 350 yards above the Brassey Mine, has yielded :—

Alethopteris aquilina.	Lepidodendron Sternbergii.
Mariopteris muricata.	——— variabilis.
Neuropteris ovata.	Stigmaria ficoides.
Pecopteris arborescens.	Calamocladus equisetiformis.

The only other fossils recorded are *Rhabdocarpus sulcatus*, and *Anthracomya Phillipsii*.

The Wetley and Shafferlong Coal-field is a very small one, 3 miles by ¾ mile. It is contained in a fold of the Millstone Grit, known as the Rudyerd Basin; there are two seams of coal belonging to the Lower Measures, but the Froghall Iron Ore is feebly represented. From the Yoredale shales in this neighbourhood he has obtained :—

Goniatites Listeri.	Aviculopecten papyraceus.
——— pancilobus.	Posidonia Gibsoni.
——— bilinguis.	Lingula squamiformis.

The Goldsitch Moss Coal-field is also 3 miles by ¾ mile. It lies in the Goyt Trough, and shows about 600—700 ft. of strata above the Millstone Grit. A complete section is seen in the stream between Wetstone Hole and Goldsitch House. Six seams of coal are recognised, the lowest of which, the Feather Edge, represents the Froghall Ironstone. From the Cannel seam are obtained:—

Lepidodendron obovatum.	Calamites Suckovii.
Stigmaria ficoides.	Ulodendron minor.

And from the black shales above:—

Rhizodopsis sauroides.	Goniatites Listeri.
Megalichthys Hibberti.	Aviculopecten papyraceus.

In some ironstone nodules and overlying shales are recorded:—

Anthracosia acuta.	Aviculopecten papyraceus.
———— ovalis.	Posidonia Gibsoni.
———— robusta.	Neuropteris affinis.
Goniatites Listeri.	

The higher coal seams, known as the Thick and the Thin, have both yielded *Rhizodopsis sauroides* and *Megalichthys Hibberti.*

The Cheadle Coal-field has a diameter of about 6 miles, and contains 12 workable seams amounting to 40 ft.; at the base lies the Froghall Ironstone. The measures are separated into Lower and Middle, the "Kingsley Rock" being the dividing boundary. The Lower are called the Churnet Valley division, and a number of sections are given, mostly from borings for the Froghall Ironstone. This is a brown hydrated ore, containing 36 per cent. of iron, from 1 to 2 ft. in thickness, generally separated from the Rough Rock by a few feet of marl. The following are the localities and depths of borings for the ironstone:—

		Depth.		Thickness.	
		ft.	in.	ft.	in.
Oakamoor ..	None found, the horizon being above.				
Crowgutter Wood ..		112	0	1	3
Mackenzie's Wood ..		156	0	1	0
Ditto	No. 1	46	9	0	5
Ditto	No. 2	33	8	0	2
Ditto	No. 3	68	11	0	11
Ditto	No. 4	60	10	0	4
Ditto	No. 7	43	6	0	3
Clough Head		28	4	1	6
Booth's Wood		124	8	1	0

From 15 to 40 yards above, is the "Stinking Coal"; 40 yards above, is the "Sweet." The Middle Coal Measures are divided into the Dilhorne series, with seven coal seams, and the Cheadle series with four, giving a total of 32 ft. 10 in. of coal, but there are no ironstones. A section of the Dilhorne series is given, showing strata to 707 ft. to the

bottom of the "Stinking" Coal (of this series); also another at Draycott Cross, showing 491 ft. 6 in. to the base of the Four-foot coal. The most important coal occurs in the Cheadle series. It is the Woodhead coal, 3 ft. thick; this is very constant, and has now been proved to the extreme west of the field. A section at the Cheadle Park Colliery is given, showing 538 ft. to the base of this coal, and another at Park Hall, showing 582 ft. 8 in. At the base of this pit, a bore-hole has been made down to the rough rock, proving the continuance of the lower coal measures. A complete sequence of the whole series is thus obtained. Summarized, this gives:—

	ft.	in.		ft.	in.
Strata..	30	0	Strata..	360	0
"Sweet" Coal ..	—	9	Coal	0	4
Strata..	96	0	Strata..	79	0
"Stinking" Coal ..	3	9	Coal	0	3
Strata..	54	0	Strata	55	9
"Man's" Coal ..	1	6	"Stinking" Coal ..	2	0
Strata..	121	0	Strata..	30	4
"Cobble" Coal ..	2	6	Conglomerates ..	1	3
Strata..	150	2	Strata..	28	8
"Rider" Coal ..	2	3	First Grit, 8 ft.		
Strata..	120	9			
"Woodhead" Coal..	3	0		1,143	3

There are, moreover, about 400 ft. of strata above those here pierced. The fossils here obtained are:—from an ironstone immediately above the Froghall, *Anthrapalæmon Grossarti*.

From the Stinking Coal Shale:—

Rhizodopsis sauroides.
Goniatites Listeri.
Posidonia Gibsoni.
——— Molyneuxi (M.S.).
Aviculopecten papyraceus.
Lingula mytiloides.
——— squamiformis.

From the Woodhead Coal Shale:—

Rhadinichthys Monensis.
Platysomus parvulus.
Rhizodopsis sauroides.
Megalichthys Hibberti.
Cœlacanthus lepturus.
Helodus simplex.
Ctenoptychius apicalis.
Diplodus gibbosus.

From the Litley Coal Shale:—

Megalichthys Hibberti.
Anthracomya Phillipsii.
Anthracosia ovalis.
——— robusta.

The remainder of the paper is occupied by a list of the species found in the Mountain Limestone, Yoredales, Millstone Grit, and Coal Measures. The latter have references, localities, and horizons given. The Plants have been arranged by R. Kidston [but the printing demands a caution, for the subdivisions marked by the same type are of very unequal value, *e.g.*, Plantæ, Filicaceæ, Pecopterideæ, and the same is the case with the Mollusca. Some of these are figured on Plate I., and it is demonstrated that the names

assigned to these must be received with caution. Thus, a species is called *Anthracoptera carinata* in the description, and *Anthracomya* in the plate. The latter of these is referred to *Anatinidæ* on p. 125, the former to *Unionidæ* on p. 129, but both to *Mytilidæ* on p. 30. The specimen called "*Modiola lithodomoides*" has not the aspect of that genus, but resembles an *Anthracosia*. The shell referred to *Anthracomya modiolaris*, has the aspect an *Anthracoptera*. The two figures of *Anthracosia aquilina* represent different species]. Descriptions of species, &c., will be found under Vertebrate and Invertebrate Palæontology.

165. Roeder, Chas. — Notes on the Upper Coal Measures at Slade Lane, Burnage.

Trans. Manch. Geol. Soc., vol. xxi., p. 114.

The Upper Coal Measures in the cutting show traces of erosion at their junction with the Permian. A section is given of 457 ft. in length, showing the succession of the beds, 50 or more in number, including 12 limestone beds, all identical with the Ardwick Spirorbis Limestone; the section really extends 425 ft. further. The limestones are light to deep pink; the clays all colours. In these various bands, which are described in full detail, occur the following:—small Labyrinthodont phalanges; *Diplodus gibbosus*, tooth; *Rhizodopsis sauroides*, tooth and scale, and spine; *Ctenodus ?* bones; *Anthracomya Phillipsii; Posidonomya ? venusta; Spirorbis carbonarius; Carbonia fabulina; C. bairdioides; C. Roederiana; C. pungens; C. secans; C. Rankiniana; C. Salteriana; Bairdia? mucronata.* Some of these limestones are brecciated, which he thinks due to contemporaneous upheaval, and more or less transportation.

166. Strahan, A.—The Geology of the Neighbourhoods of Flint, Mold, and Ruthin.

Memoirs of the Geological Survey.

The Carboniferous rocks occur in two chief areas: the Vale of Clwyd and the main mass east of the Moel Fammau Range.

The Vale of Clwyd is bounded on the east by a fault which lets down the Lower Mountain Limestone against the Wenlock shales. This statement "differs considerably from that offered in 1850 in the first edition of the map," in which overlaps were shown that are now known not to exist. The correction has been made by the discovery that the limestone on the east, supposed to be at the base, is really near the top of the Mountain Limestone. The fault is shown by a figure to have a throw of 1,500 feet, and is called the Vale of Clwyd Fault.

The Basement beds of the Carboniferous are continuously exposed along the western side, where they are

unconformable to the Wenlock shale, and consist of conglomerates, but they appear only at Cwm, and Penbedw on the east side, but they are seen in the valley of Clywedog beyond the map.

The Carboniferous rocks on the eastern side of the vale are then traced, at Penllwyn; Tron-yw; in the stream at Rhiw-pebyll, and a little further south as a wedge between two sides of a split in the fault, which is impregnated, as elsewhere hereabouts, by barytes; at Groes-fawr, Pentre, where the purple Coal Measures come against the Wenlock; as also at Llangynhafal; Brynbedw, limestone widening southwards. At Plâs Drâw, the Trias sandstone is deposited against a cliff-like band of purple carboniferous sandstone (fig. 2). Below Bron-y-felin, the purple beds are best seen with a conglomeratic base; thus they occupy the place of, but show no resemblance to, the Millstone Grit, being micaceous and felspathic and containing much shale. They resemble more the overlying beds in Flintshire, and he concludes that the Millstone Grit has died away. Other exposures are at Llanbedr Hall, Caegras Quarry, and above Ysgabor. On the western side, the limestone is seen in the Valley of Clywedog, where it is white; at the quarries of Pen-y-graig, with a pebbly base; and south from Llanfwrog. The highest beds crop out at Coed Marchan, and the lowest in a quarry north-west of Galchog.

East of the Moel Fammau Range.—The Carboniferous Series in this area is divided into the following:—

Middle Coal Measures.
Upper Coal Measures.
Millstone Grit.
{ The Black Limestone (North Flintshire).
{ The Calcareous Sandstone Series (South Flintshire).
The Grey and White Limestone.
The Lower Brown Limestone.

The Lower Brown Limestone is traced along the western edge from north to south. It is well seen at Coed Maes Mynau, dipping at right angles to the Wenlock shale. It shows an alternation of black and porcellanous limestones for 19 ft. Next, at Afon Ffynnon Fair it is argillaceous and bituminous, with plant remains in shales; at Nannerch Station; at Penbedw Park. From here it is mostly traced by means of swallow holes, as at Craig, Tafarn-y-gelyn, and Llanfarres. At Bryn-y-gloch is a conglomeratic band, with quartz pebbles.

The grey and white limestones are massive, pure, crystalline, and light coloured, and form the larger hills and plateaux, and have a thickness of 2,570 ft. They are described at Croes, Waen, Hafod Dew, and Pen-y-ball top, a section of which is given (fig. 3). At Bryn Sannon it has

bands of chert and *Producti* coated with Beekite. Below this lies the "Halkin Marble," worked at Halkin Hall, where it is encrinital. Two inliers are exposed south of Moel-y-gaer, and there are many faults. One of the most complete sections is at Hendre, where, below a thin capping of higher beds, 469 ft. in 19 distinguishable beds are seen, including the Black Limestones. Two of the bands contain abundant corals, and several "courses" occur towards the east. It is well seen again in Alyn Valley, and at Erw Felin Mine the shaft pierced 659 ft. of limestone, with sandstones near the top (details given). In the succeeding range, between Bryn Celin and Llyn-y-pandy, it is divided by lead-bearing east and west faults. There are also north and south faults repeating the sandstone beds. Between Llyn-y-pandy and Pant-y-mwyn, the belt has three sandstones, one of them with quartz pebbles; there is also a coral band, a white saccharoid band, and white limestone cliffs. Here the Alyn disappears in a swallow hole. The belt from Pont-y-mwyn to Pant-y-buarth has a less important vein at Bwlch-y-idranfryn (section, fig. 6) with a downthrow north. Between Pant-y-buarth and Gwern-y-mynydd, the strata are much broken and a grey encrinital rock is much quarried. From below the coral bed a mass of limestone rises in Cefn Mawr Hill. At Gwern-y-mynydd a section is given showing 2,570 ft. below the Millstone Grit, divided into 23 parts, consisting of Passage beds, 500 ft., Main Limestones 1,670 ft., Lower impure Limestones 400 ft., the details being quite different to those at Hendre and the corresponding beds thicker. The upper sandstones are shown on Moel Findeg (fig. 8). Towards the east, one of the limestones appears to perish along the outcrop, bringing the beds above and below almost together. The hill is further complicated by the Cat Hole cross course and the Maes-y-safn vein. Between Pant du and Belgrave vein, the main limestone rises on the east to 1,324 ft., forming a prominent point in the escarpment, and the beds are thrown into anticlinals. The summit shows a deeply grooved and fluted surface. Near Castell, are two coralliferous limestones, with an intervening quartz pebble sandstone. Near Bog Mine, trilobites and plants may be found. Hope Mountain is an inlier where the Carboniferous Limestone is brought up by the Bala fault on the south, and shows the greater development of the sandstones towards the top of the series, a feature which has been coming on gradually, as the beds are traced south (fig. 9).

The Black Limestone is only recognisable as a distinct division in the northern part as far as Pen-y-ball. It contains the so-called "Aberdo" limestone, named from its resemblance

to the Liassic Aberthaw limestone in S. Wales. It is worked at Trelogan, Gorsedd, and Holloway, and on Pen-y-ball common. It is thin bedded and hydraulic. It is also worked on Halkin Mountain, where it is very rich in *Fenestellidæ*, described by Mr. Shrubsole (Q.J.G.S., vols. xxxv. and xxxvii.) Further to the south, new bands of Black Limestone come in, but there is no evidence that they are on the same horizon.

The Millstone Grit changes very much in character as it is traced from north to south, commencing with beds of massive chert. It gradually assumes a sandstone character, and finally becomes a pebbly grit. It cannot, therefore, be considered as a rock of purely organic origin, and some parts—as the "buhrstone" of Halkin Mountain—are silicified from limestones. Near Trelogan, at Afon Goch quarry, banded chert is seen at top and bottom, and between is encrinital chert and a band half chert, half limestone. The thickness of the chert is estimated at Trelogan mine at 140 yards [but the data *prove* no more than 70 odd, no allowance being made for undulations or faults]. Other exposures are described at Pentreffynon, Saith Aelwyd, where the character is changing; Coed-y-fron; and the hills of Bryn-mawr, where it is worked for pottery. Hereabouts the change becomes rapid. At Joel Farm there are quartz pebbles in it. After the Nant-figillt fault, the chert and quartzose sandstone finally thins out. At Hendre, 11 ft. 6 in. only can be recognised, and it is quartzose sandstone, and a little further on the beds above and below are in contact. After a space of 1½ miles, however, it comes in again as a pebbly coarse sandstone, which develops rapidly southward into a great series of sandstones and cherts. This overlap is unaccompanied by an unconformity. At Fron Fawnog it is 100 ft. thick. Near Fron Haul Mine, there is a thin band of limestone in the midst called Little Flat, and the total thickness is 300 ft. At Maes-y-safn it has increased to 435 ft. At Tir-y-coed, only part is shown, and is 342 ft. It is seen on the slopes of Mynydd-du, near which it is seen to undulate, and at Cil-y-waen it contains brachiopods, and is seen again in the bed of the Cegidog. Round Hope Mountain, Grits are seen, and on Caergrole Castle Hill, the Millstone Grit is represented by coarse white sand.

The following fossils are recorded from the Carboniferous Limestone of this district, * also in the Millstone Grit:—

Palæocoryne scoticum, Yg.	Chonetes papilionacea, De Kon.
Alveolites septosa, Flem.	Discina nitida, Phil.
Clisiophyllum bipartitum, M'Coy.	Lingula squamiformis, Phil.
———— turbinatum, M'Coy.	Orthis Michelini, L'Ev.
Cyathophyllum parecida, M'Coy.	——— resupinata, Martin.
———— regium, Phil.	Productus aculeatus, Martin.

Cyathophyllum Stutchburyi. M. Edw.
Lithostrotion basaltiforme, Conyb.
———— cæspitosum, Martin.
———— irregulare, Phil.
———— junceum, Flem.
———— M'Coyanum, M. Edw.
———— Portlocki, M. Edw.
Lonsdaleia duplicata, Mart.
———— floriformis, Mart.
———— rugosa, M'Coy.
Monticulipora tumida, Phil.
Phillipsastræa radiata, Woodw.
Syringopora geniculata, Phil.
———— reticulata, Goldf.
Zaphrentis Bowerbanki, E. and H.
———— cylindrica, Scouler.
———— Enniskilleni, E. and H.
Archæocidaris Urii, Flem.
Phænoschisma acutum, Phil.
Poteriocrinus crassus, Miller.
———— nuciformis, M'Coy.
Serpulites carbonarius, M'Coy.
Brachymetopus auralicus, De V.
Griffithides seminiferus, Phil.
Leperditia suborbiculata, Münst.
Fenestella halkinensis, Shrubs.
———— membranacea, Phil.
———— nodulosa, Phil.
———— plebeia, M'Coy.
———— polyporata, Phil.
Glauconome bipinnata, Phil.
Goniocladia cellulifera, Eth., Jr.
Rhabdomeson gracilis, Phil.
Athyris ambigua, Sow.
———— expansa, Phil.
———— planosulcata, Phil.
———— Royssii, L'Eveillé.
*Chonetes laguessiana, De Kon.
Productus conoides, Sow.
———— cora, D'Orb.
*———— costatus, Sow.
———— fimbriatus, Sow.
———— giganteus, Mart.
———— latissimus, Sow.
———— llangollensis, Dav.
*———— longispinus, Sow.
———— margaritaceus, Phil.
———— punctatus, Mart.
*———— semireticulatus, Mart.
———— Youngianus, Dav.
Retzia radialis, Phil.
Rhynchonella pleurodon, Phil.
Spirifera elliptica, Phil.
———— glabra, Mart.
———— lineata, Mart.
*———— pinguis, Sow.
*———— trigonalis, Mart.
Spiriferina cristata, Schl.
———— laminosa, M'Coy.
*Streptorhynchus crenistria, Phil.
Terebratula hastata, Sow.
———— sacculus, Martin.
Aviculopecten granosus, Sow.
———— micropterus, M'Coy.
———— plicatus, Sow.
Pinna flabelliformis, Mart.
Sanguinolites curtus, M'Coy.
Solemya puzosiana, De Kon.
Euomphalus Dionysii, Goldf.
Murchisonia Kendalensis, M'Coy.
Bellerophon tenuifascia, Sow.
Goniatites sphæricus, Mart.
Orthoceras giganteum, Sow.
Cladodus mirabilis, Ag.
Petalodus Hastingsiæ, Ow.
Psammodus porosus, Ag.
Streblodus oblongus, Ag.

The Lower Coal Measures consist of two parts: black shales with cement stones below, and variable massive sandstones above. The base consists of the black Holywell shales, which resemble lithologically and by their fauna some Lancashire Lower Coal Measure shales. They are described in three lccalities. The *Calcoed outlier* is very little seen, and is introduced by a triangle of faults, the evidence for which is given. *From Holywell to Hope.* At Coed-pen-y-maes, 33½ ft. of Black shales, with two narrow beds of cement stone, are seen. The cement stone is worked at Coed Llwybr-y-bi, and there are found *Posidonomya Gibsoni*, *Aviculopecten papyraceus*, &c. They are seen also at Halkin. The ganister beds may be seen near Gwysaney, 18 ft. thick. In the Nant-figillt ravine, where the Coal Measures are faulted down, ganister, shales, and sandstones, with a thin band of coal underlain by fireclay, may be seen, and in the Trig the black shales

and cement stones. *Hawarden and Tryddyn.* The ganister beds are here well seen, and are sometimes conglomeratic.

The Middle Coal Measures constitute the workable portion of he series. The general description is by **C. E. De Rance.** He divides the field into three parts, the northern, southern, and eastern, and gives a general section of the two former. Vertical sections, sheets 77-78, however, have already illustrated the sequence. In the Northern area, there appear to be 988 ft. of measures with 15 named coal seams, seven of which are 6 ft. and over, the "five yard" being 12 ft. In the Southern, there are 1,018 ft. of measures with 25 named seams, five being 6 ft. or over. The remainder of the description is taken up with the correlation of different seams in different distant mines, and miscellaneous notes about thicknesses and intervals, and yields nothing of general interest. The "Buckley Fire-clay" is part of this series, and its surface exposure is bounded on either side by faults [so that its position in the series appears to be unknown, and is certainly not stated]. Sections are given at Northop Hall, Tryddyn, Buckley, Brookhill, and Mount Pleasant. These show a varying series of fire-clay, white rock, yellow shale, white shale, dark shale, and very thin seams of coal, generally only one of the latter. The Neston Coal-field is part of the Flintshire series on the northern side of the Dee. The Leeswood Coal-field (described by **A. Strahan**) is bounded by faults on both sides, that on the east is the continuation of the Brymbo fault, and its throw may be appreciated on Hope Mountain, whose base it skirts, since it is about twice the height of that hill. Near Frank Farm, the main coal was missing over an area about 100 yards square, but on the north and south side of the barren area, the missing coal has been pushed over the surface of the rest, so as to double its thickness and repeat all its peculiarities. This is spoken of as a slide fault. There is also a great "wash out" in the cannel coal, of which a plan is given, and which was described by N. R. Griffith in 1870. [Trans. N. Eng. Inst. Eng., vol. xix.] The two principal coals are the main—of the following sample constitution—

	ft.	in.
Shale with nodules of ironstone	8	0
Top coal, 3 ft. Furnace coal (soft), 3 ft. 6 in. Bottom coal, 4 ft.	10	6
Black carbonaceous shale and coal	2	3
Little coal	2	3
Grey underclay with ironstone	4	5

and the cannel, which is 93 yards below, consists of smooth cannel shale and curly cannel, of which the last is the best, total at the thickest 5 ft. 9 in.

Details of colliery sections are given in an appendix. At Bagillt (2), Coleshill, Flint, Marsh, Connah's Quay, Hawarden (3), Queen's Ferry, Aston, Mancot Bank (2), Ewloe (2), Northop (3), Northop Green, Oaks Pit Mold, Broncoed, Bron Wylfa, Old Pentre Hobin, Nerquis, Coed Talwrm, Leeswood Iron, Latchcroft, Gorsts Farm, Sandycroft (4), Saltney (2).

167. Piper, G. H.—On the Coal Measures at the Clee Hills.

Trans. Woolhope Naturalists' F. C. for 1883 (published in 1890), p. 82.

Amongst general remarks, notes fine specimes of *Orodus ramosus*, obtained by Mr. Weaver Jones, of Cleobury, at Oreton Quarry, and *Ctenacanthus*, from Knowbury.

168. Morgan, C. Lloyd.—The Geology of the Wick Rocks Valley.

Proc. Bristol Nat. Soc., N.S., vol. i., pt. ii., p. 183.

This valley is at the overlap of the Trias with the Carboniferous. The latter begins in the west with Millstone Grit, and is followed first by the Upper Transition beds, and then by the Upper Limestone with fossils, strike nearly north and south and dip 55° west, making the Upper Transition beds 600 ft. thick. To the east, Millstone Grit is twice faulted in again.

169. McMurtrie, G. E. J.—The Somersetshire Coalfield.

Journal Brit. Society Mining Students, vol. xii., p. 161.

This is, to a large extent, a compilation of published papers. At the Kingswood and Parkfield Collieries, an overlap fault has been recently discovered like the Radstock fault, but particulars are not given.

170. Dawkins, W. B. — The Discovery of Coal Measures near Dover.

Trans. Manch. Geol. Soc., vol. xx., p. 502.

After an account of the development of the idea of coal being below the south-east of England, a section of the bore-hole is given, showing Cretaceous 500, Jurassic 660 [down to Bathonian, and, therefore, the Lias and Trias are absent] and then "Coal Measures, sandstones, and shales and clays, 20 ft., with one seam of coal." He calls this a "seam of good blazing coal," but nothing more is said about it. [Has a sample ever been exhibited?]

171. Whitaker, W. — "Coal in the South-East of England."

Geol. Mag., Dec. 3, vol. vii., p. 13.

A mere letter—nothing new.

Whitaker, W.—Suggestions on Sites for Coal Search in the South-East of England.

Geol. Mag., Dec. 3, vol. vii., p. 514 (read at B.A.).

He suggests seven suitable places where borings have already been made:—(1) St. Margaret's, probably less Wealden than at Dover; (2) Chartham, for same reason; (3) Chatham, absence of Upper Jurassics and the Lower probably thin; (4) Shoreham (Kent), starts low in the series; (5) Bushey; (6) Loughton. These borings would at least be interesting. Also at Seven Coombs, not far from Harwich, where Carboniferous rocks are known to occur.

[**172.**] **Dawkins, W. B.**—The Search for Coal in the South-East of England.

A lecture before the Royal Institution [not published in 1890].

[**173.**] **Mills, R. J. M.**—The Dover Coal Basin and its Foreign Connections.

Paper read to the Derbyshire Archæological and Natural History Society on May 13, but not published in 1890.

[**174.**] **Hull, E.**—On the Recent Discovery of a Concealed Coal-field in the South-East of England.

Paper read to the Royal Dublin Society on March 19, but not published in 1890.

175. Mello, J. M.—The Dover Coal-field and its Connections.

"Midland Naturalist," vol. xiii., pp. 170, 230.

A general discussion of the question on data derived from various sources.

176. Martin, E. A.—Kentish Coal.

The "Field Club," No. vi., p. 84; No. vii., p. 105.

General discussion of the subject.

177. Henderson, John.—On the Succession of the Lower Carboniferous Series to the West of Edinburgh, with Special Reference to the District round Cramond.

Trans. Edin. Geol. Soc., vol. vi., p. 29.

He has shown that there are two anticlinals, one from Leith to Blackford Hill, the other from Stanton Quarry to Wood Hall. From Blackford Hill by Arthur's Seat to Dean Bridge, we pass over sandstones and shales, which he calls the "Granton Sandstone Group," till we reach the "Wardie Shales." Further south, along the synclinal, we get the higher sandstones and shales of Colinton, Slateford, and Hailes Quarry, up to those of Redhall. Beyond the western anticlinal, nothing higher is seen, the upper part being cut off by a great fault. From Granton Breakwater westwards, the sandstones of the series may be seen, which are correlated with the above by measurements of thickness determined by dip; the uppermost bed is finely laminated as in Hailes Quarry. Above this (which is 160 ft. thick) on the shore comes: (Covered 100 yards) Trap, 50 yards; Sandstones and Shales, 50 yards; Trap, 30 yards; (Covered

200 yards) Sandstones at Cramond, ? yards; Trap, 100 yards; (Covered 200 yards): Trap ? yards; (Covered 300 yards) Sandstone of Eagle Cliff. This last has oblique lamination; then thick and thin bedded sandstones, 400 yards; Trap, ? yards. In the last-mentioned shales, fragments of scorpion have been found. The sections up the Almond river are too isolated and irregular to make out any sequence; there are traps and black shales, those further up being vertical and oil-bearing; all this is below the Burdiehouse Limestone.

178. Hunter, J. R. S.—Geology of the Upper Ward of Lanarkshire.

"Colliery Guardian," vol. lx., p. 13.

He classes the beds of the district as follows: (1) Lower Coal Measures from the Calciferous Sandstone to below the *Productus* beds; (2) the Lower Carboniferous Limestone; (3) the Middle Coal Measures from the gas or cannel coal to those immediately above the Carluke first coal; (4) the Upper Carboniferous Limestone.

179. Nolan, J.—Explanatory Memoir of Inishowen, County Donegal.

Memoirs Geol. Survey, chapter v.

Strata referable to the Calciferous Sandstone Series occupy a strip of country along the west shores of Lough Foyle, from Craigboy to Culmore. It is separated from the schists by a fault. The beds consist of red and flesh-coloured coarse sandstone, pebbly quartzose sandstone, and conglomerate.

180. Hendy, J. C. B.—Notes on a "Wash-out" found in the Pleasley and Tevershall Collieries, Derbyshire and Notts.

Q.J.G.S., vol. xlvi., p. 432. *See* also p. 1 of Proceedings.

This "Wash-out" is a lenticular mass of sandstone in the midst of the Top Hard Coal. It has been followed for 600 yards in the Tevershall Colliery, and, after an interval about as long, for 200 yards in that of Pleasley. Four headings have been driven through it in the first range, and one in the second. In the first section, the coal commences to thicken about 60 yards from the Wash, till it is parted in the middle by a wedge of sandstone which leads to the Wash, which is 34 yards wide, and finally cuts out the coal. This comes in again as a wedge at the bottom on the other side, being mixed up with the sandstone near the junction. The bands in the Wash form a shallow basin. The floor, which is otherwise undisturbed, shows wrinkles transverse to the direction of the Wash, and striæ parallel to it. In sections 2, 3, the Wash is divided into two branches, both in the

form of basins, 40 and 50 yards wide, with 46 yards run of coal between, which is here thicker, and has intercalated tongues of sandstone. In section 4, the branches are united again, and the floor is eroded over spaces of 7 and 10 yards, and the sandstone bed below is furrowed and rippled. The upper part of the coal seam has been re-deposited, and has masses of sandstone at its base, the total width being 75 yards. In section 5, the roof, which is here of clay, is also cut out; the coal is also thickened. In the lower part, the associated cannel dies out, but is increased in the upper part, and between these the Wash runs in in a tongue on each side, and the clay floor is here unaffected. This Wash cannot be due to faulting, as the underclay is not faulted, but is formed by overflows of water denuding the coal and depositing it at a lower level, and also in part to pressure, both lateral and vertical. The Wash-out described by Mr. Coke as occurring at Blackwell, is in the Deep Hard, which is some 200 yards below.

[**181.**] **Lebour, G. A.**—On Ancient "Washes" in the Coal Measures.

Paper read to the N. of England Inst. of Min. and Mech. Eng. on June 14th, but not published in 1890.

182. Stirrup, M.—Alleged Recent Discovery of a Fossil Forest in Scotland.

Trans. Manch. Geol. Soc., vol. xx., p. 412.

A fossil forest has been announced in a newspaper as having been discovered at Tranent Collieries, 10—12 miles east of Edinburgh. The writer has examined the spot, and finds that though there are several erect stems of possibly Lepidodendroid trees, standing vertically to the stratification in a bed of clay above the coal seam, yet they are cut off horizontally, both above and below, and show no remains of roots. He concludes that they are only drifted stumps, and have not come from far. There is, however, a true forest at Whiteinch, near Glasgow, described by Messrs. Young and Glen in the Transactions of the Geological Society of Glasgow for 1888.

PERMIAN.

183. Roeder, Chas.—Notes on the Upper Permians, &c., at Fallowfield, lately laid open.

Trans. Manch. Geol. Soc., vol. xx., p. 615, with two plates of sections.

These are seen in a new railway cutting. Commencing at Ladybarn Lane, the strata dip west at 15°, and the Trias "rests on the slopes of the Permian marls, which are cut off to the west by a fault." Below, and measured horizontally,

are seen [thickness = feet stated × sin 15° (= about ¼)] marls 36 ft., greenish white limestone 6 ft., micaceous sandstone 6 ft., marls 36 ft., sandstone 15 ft. (Boulder clay 27 ft., ditto, reddish, 51 ft.). These are called Upper Permian. Then come white and red conglomerates 34 ft., red coarse sandstone 45 ft., soft micaceous sandstone 1,446 ft., called Lower Permian, and this overlaps the purple marls of the Coal Measures. [It is said conformably, but the figure shows some conglomerate dying out between the two beds]. The upper beds are too contorted to estimate, but the lower ones may be 500 ft. He then describes in detail 31 beds in 98 inches; some are ripple marked, and contain on their surface ridges of congregated shells—the best are in the ferruginous bands.

184. Roeder, Chas.—Notes on the Permians and Superficial Deposits at Fallowfield.

Trans. Manch. Geol. Soc., vol. xxi., p. 104.

This continues the detailed section downwards from his former paper. The marls have thin shelly partings, but there are no shells *in* the marls. They contain calcareous nodules, sometimes septarian, which he thinks were rolled on the sea-shore and collected shells round them. The coming on of the Boulder clay may be due to a fault. He considers the contortions in the upper clay as not due to surface glacial action, as there is none in the Boulder clay above, nor known elsewhere, but to the lateral fault-producing pressure. Moreover, the movement of the Boulder clay could have been neither from east nor west, on account of the absence of the boulders it must in those cases have brought; but from north to south, as Carvill Lewis believed; *i.e.*, the pressure would have to be parallel to, and not perpendicular to, the crests of the contortions.

185. Geinitz, H. B.—On the Red and Variegated Marls of the Upper Dyas, near Manchester.

Trans. Manch. Geol. Soc., vol. xx., p. 537. Translated from "Ges. Isis in Dresden," 1889.

This is really a description of the fossils sent over to him by C. Roeder for examination and naming. They are—*Schizodus Schlotheimi*, Gein.; *S. rotundatus*, Brown; *S. obscurus*, Sow.; *S. truncatus*, King; *S. rossicus*, de Vern.; *Edmondia elongata*, Howse?; *Pleurophorus costatus*, Brown; *Clidophorus Pallasii*, de Vern.; **Aucella Hausmanni*, Goldf.; **Avicula Kazanensis*, de Vern.; *Gervillia antiqua*, Münst.; *Natica minima*, Brown; *Turbo helicinus*, Schl.; *T. obtusus*, Brown; *Rissoa Gibsoni*, Br.; **Dentalium Speyeri*, Gein.; **Vermilia obscura*, King; *Filograna Permiana*, King. Of plants there are three—*Voltzia Liebeana*, Gein.;

Those with * have not been found before in the district.

Guilielmites permianus, Gein.; *Spongillopsis dyadica*, Gein. These place the marls on the horizon of the Upper Zechstein.

186. Roeder, Chas.—Description of Fossils found in the Permian Upper Series at Fallowfield.

Trans. Manch. Geol. Soc., vol. xxi., p. 13.

The fossils were found in the railway section, and have been sent to Dr. H. B. Geinitz to name. They are as follows:—*Schizodus Schlotheimi*, which, in the marls, have still their "delicate yellow pellucid shell substance," *S. rotundatus*, *S. obscurus*, *Pleurophorus costatus*, in limestones, red marls, and ferruginous seams—in the last, best. *Clidophorus Pallasii*, *Aucella Hausmanni*, *Gervillia antiqua*, *E. ceratophaga*, *Leda speluncaria*, Gein., the two latter new to the district. *Natica minima*, *Turbo helicinus*, *T. obtusus*, *Rissoa Gibsoni*, very common, *Discina Konincki*, *Filograna Permiana*, *Vermilia obscura*, only in limestones and ironstones. Of plants, there are *Voltzia Liebeana* from the red marls, *Guilielmites Permianus*; all these are fine, and well preserved.

The section was described by Mr. Sington. The beds dip at 20° [direction not given]. At the base is limestone, 12 inches, then 8 or 10 in. of clay, then a 4 ft. 6 in. limestone quarried at Ardwick, and, finally, a series of clays, with 13 beds of limestone.

187. Howse, R.—Note on the South Durham Salt Borings, with Remarks on the Fossils Found in the Magnesian Limestone Cores, and the Geological Position of the Salt.

Nat. Hist. Trans. of Northumb., Durham, and Newcastle-upon-Tyne, vol. x., pt. ii., p. 220.

The object of this paper is to show that the salt-bearing beds of Durham lie below the Upper Permian Limestone, or equivalent of the German Platten-dolomit, and in the Lower Red Marl. He does this by giving comparative sections of the Saltholme Trial Bore, a bore-hole near Gera, and Sedgwick's description of South Yorkshire Permian beds. With regard to the first, the Rock Salt 35 ft., Shale 8 ft., and Gypsum 13 ft., at the top of the section, he places in the Trias. The Gypsum and Limestone 12 ft., Limestone 45 ft., Grey Limestone 9 ft., Grey Limestone and Gypsum 11 ft., he places in the Platten-dolomit; and the remainder, including Rock Salt, 14 ft., in the Red Marl. From the cores of the Newcastle Chemical Works, on Tees side bore-hole, he found *Chondrites virgatus*, *Myalina Hausmanni*, and *Axinus dubius;* in the Seaton Carew bore-hole, *Productus horridus* and *Axinus dubius*. *See also* No. **191.**

188. Green, A. H.—A Word or Two about the So-called Concretionary Structures in the Magnesian Limestone of Durham.

Rep. Brit. Ass. for 1889, p. 597.

It is suggested that these Limestones were originally tufaceous deposits, and that their form was in part due to irregular precipitation. In some cases, subsequent molecular re-arrangement had produced radiated and other crystalline structures in them.

189. Tute, J. S.—Notes on some Singular Cavities in the Magnesian Limestone.

Proc. Yorks. Geol. and Polyt. Soc., New Ser., vol. xi., p. 182, pl. vi.

These are curved cavities in the Permian Limestone of Wormald Green, which the author compares to those mentioned by Kirkby, at Hampole. Those figured on the plate are not described, but some of the cavities have irregular sides and an inconstant curvature.

190. Gresly, W. S.—Evidence Furnished by the Quaternary Glacial-Epoch Moraine Depositsof Pennsylvania, U.S.A., for a Similar Mode of Formation of the Permian Breccias of Leicestershire and South Derbyshire.

Abstract in Proc. Geol. Soc., p. 114.

Some large, subangular, grooved or striated boulders of sandstone, about a ton in weight, have been met with in the workings of a coal mine in South Derbyshire, lying immediately upon eroded Coal Measures in Permian Breccia beds, at a depth of about 600 ft. These boulders much resemble those found lying on the coal beds of Pennsylvania, which belong to Glacial Boulder beds, and the conclusion is that these Permian Boulders have had a similar origin.

TRIAS.

191. Howell, H. H.—" Note on the Classification of the Red Rocks in S.E. Durham, and on a possible unconformity between the Trias and the Permian Limestone in the same district.

Geol. Mag., Dec. 3, vol. vii., p. 8.

This is chiefly an answer to the observations of Prof. Lebour, in his " Outlines of the Geology of Northumberland and Durham," 2nd ed., 1886, reprinted in his " Official and Local Guide " for the British Association in Newcastle, in 1889.

The beds between the Rhætic and Thick Magnesian Limestone, are divided by Prof. Lebour into three parts, which he calls the Upper Trias, Lower Trias, and Upper Permian, all separated by possible unconformities. Mr. Howell, on the other hand, classes only the limestones as Permian, including thereby part only of Lebour's " Upper Permian," and all the rest as Keuper, in which he is supported

by Mr. E. Wilson. With regard to the upper 400 or 500 ft. of Red Marls, there is no difference of opinion; but in this district there is below this an abnormal thickness of sandstones, &c., with gypsum and rock salt. These are very seldom exposed, owing to the drift, but are seen at Seaton Carew, where there is a bore-hole. They are not in the least like Bunter anywhere else, and there is no sign of a physical break. He thinks, however, there is a possible unconformity between these and the limestones, because at Seaton Carew they lie on the Upper Limestone of the Hartlepool cliffs, as they also do at the Newcastle Chemical Co.'s bore-hole on the north side of the Tees, opposite Middlesbrough. The limestone here is scarcely fossiliferous, but yields casts of *Axinus dubius*, like those of the Hartlepool cliffs. In the western outcrop, however, at Leeming Lane, the gypsum beds lie on the compact fossiliferous limestone, which is lower in the Permian series.

He then discusses the age of the lowest gypsum-bearing beds in the Saltholme boring, which were referred to as Permian by Sir A. Ramsay, but which Mr. E. Wilson (Q.J.G.S., Nov., 1888), considers Keuper by their general appearance. Mr. Howell, therefore, gives analyses to show they are either true limestones or dolomites.

	From 1,261 ft.	From 1,320 ft.
Carbonate of Lime	54·71	94·48
„ „ Magnesia	41·18	2·98
„ „ Iron	·81	.78
Silica	2·00	1·20
Alumina	trace	0·20
Water	1·08	—
Bitumen	·22	·36
	100·00	100·00

192. Strahan, A.—The Geology of the Neighbourhoods of Flint, Mold, and Ruthin.

Memoirs of the Geological Survey, chapter ix.

The Trias of Cheshire and Flintshire, out of the Vale of Clwyd, has yielded all three subdivisions of the Bunter, the sections of which described by Prof. Hull are still the only ones available.

In the Vale of Clwyd, the New Red Sandstone consists of highly current-bedded bright red sand, with scarcely any pebbles. No dip can be observed, though from the uniform high inclination of the planes of current bedding west of Moel Fammau, it is believed there is a true dip away from the hill. The thickness is also unknown. The overlap is not great, for it almost always lies on the Middle Coal Measures, and at most reaches the Carboniferous Limestone by overlap. This proves, however, an unconformity between them. Exposures

are mentioned at Plas Ashpool, Felin Uchaf, Ty Coch, Llangynhafol, Fron Ganol, Llanbedr Hall, and round Ruthin.

193. Morton, G. H.—Notes on the Bunter and Keuper Formations in the Country around Liverpool.

Geol. Mag., Dec. 3, vol. vii., p. 497. Read to the Brit. Assoc. on Sept. 9.

The actual thickness and character of these rocks have been observed in many excavations and borings, and they may be roughly stated as follows :—

		ft.
Keuper	Red Marl	400
	Keuper Sandstone	400
Bunter	Upper Soft Sandstone ..	550
	Upper Pebble Beds ..	400
	Lower Pebble Beds ..	600
	Lower Soft Sandstone ..	400
		2,750

The top and bottom beds vary from a few feet to 400 feet.

The sandstones are of five kinds, varying in size of grains from $\frac{1}{25}$ to less than $\frac{1}{100}$ in. in diameter. Some of the grains in the Pebble Bed Sandstones have secondary quartz. The Lower Soft Sandstone is coarser than the Upper, and has occasional large grains. The Keuper Sandstone, near its base, is very like the Pebble Beds. The only pebbles in the Bunter are in the Lower Pebble Beds. The principal are vein quartz, quartzite, and, in smaller number, Cefn-y-Fedw Sandstone, Millstone Grit, and Coal Measures of the neighbourhood, also some felspathic grits, quartz felsites, &c., but no Carboniferous Limestone. They are in general rather like those of Staffordshire, but are smaller and not so well rounded. He doubts whether they are really less numerous, but only seem so on account of the abundance of the intervening sandstone. He then discusses, without coming to any very definite conclusion, the source and mode of deposition of the pebbles, &c.

[194.] Beasley, H. C.—On the Base of the Keuper in the Northern Part of Wirral.

Paper read to the Liverpool Geological Society on Nov. 11, but not published in 1890.

195. Andrews, W.—On the Bore-holes at Coventry.

Proc. Warwick F. C. for 1889, p. 27.

A boring to a depth of 575 ft. at Spon End, showed 80 different beds of alternating red and brown sandstones, red marls, and hard pebbly conglomerates. Most of the beds contained white discs or spheres, with a dark spot in the centre. Similar beds, 400 ft. thick, have been recorded by F. G. Meacham overlying Coal Measures at Hamstead,

north of Birmingham. These, on comparison, are seen to be identical, and, therefore, the Coal Measures ought to be immediately below at Coventry, and these rocks must be Permian [if those at Hamstead are]. Salt water occurs at the junction in both cases. At Coventry, this is really a mineral water, with sulphates of soda, magnesia, and lime, and carbonates of magnesia and lime. Another boring at Willenhall shows 31 ft. of Lower Keuper and 160 ft. of either Lower Permian or Upper Carboniferous—being red marls and sandstones. A third boring, showing similar rocks with spotted circles, is being made at Radford. Nevertheless, some rocks mapped as Permian, south of Coventry, are Trias [Small hard spheres characterise the waterstones near Nottingham].

196. Landon, J.—The Barr Beacon Beds.

Proc. Birmingham Philosophical Soc., vol. vii., part 1, p. 113. Plate.

Mr. Howell, in the explanation of the Geological Survey, horizontal section 49, says that at Barr Beacon, the Middle Bunter Conglomerate is 350 ft. thick, and rests directly on Permian strata. A cutting half-a-mile E. by S.E. of Beacon Trees, excavated for targets, shows, however, a series of sandstones, below the conglomerate, entirely devoid of pebbles, except of Permian clay. He describes ten distinct beds, each from 2 to 4 ft. thick, making a total of about 27 ft. These are, for the most part, highly false-bedded, beautifully coloured, and in lenticular masses, as shown in the plate. The upper surface is deeply eroded. Other exposures on the south and east, towards Sutton, show similar sands, always underlying the conglomerate, the pebbles of which have been washed from higher grounds and produce a pebbly covering. The pebble beds were deposited in a very uneven surface; 30 ft. difference is seen in 100 yards, and elsewhere the whole of the Lower Sandstone may be cut out. Some of the lower parts of the Pebble beds contain angular fragments derived from the Permian. The conglomerate here has a maximum of 150 ft., and the other 200 ft. belong to the Lower Red and Mottled Sandstone, which is not, therefore, absent, as has been supposed.

197. Ussher, W. A. E., and Cameron, A. G. C.—The Geology of Parts of North Lincolnshire.

Sheet 86, Memoirs Geol. Survey, chapter ii.

Waterstones are only found in borings, *e.g.*, at Sandtoft and Reedness, where there are 687 feet of sandstones below the red marl. Keuper marls are seen N.W. of Blyton, at Loughton, east of Ferry Flash. They form also the Isle of Axholme, where gypsum appears at Epworth and Burnham. Flags are found at Misterton.

198. Ussher, W. A. E.—The Triassic Rocks of West Somerset, and the Devonian Rocks on their Borders.

Proc. Som. Arch. and N. H. Soc. for 1889, N. S., vol. xv., p. 1, with a coloured geological map.

The Trias rocks fall into three subdivisions:—I. The Lower Trias. This consists of Breccia, Conglomerate, and Sand. The coarser beds occur at the top, and the sands at the base are constantly brecciated. They are much faulted. II. The Middle Trias, consisting of Red Marls, with occasional Sandstone. The superficial distribution of these beds is noted. III. Upper Trias or Keuper. The basement beds are massive Conglomerates, loose earthy gravels and sands. The gravel is composed of local materials. The Keuper Sandstones are very calcareous, and almost become Marlstones, and at Bagborough are burnt for lime and have thus been taken for Muschelkalk. The upper part is the Keuper Marl. The distribution is then noted with the outliers.

199. De Rance, C. E.—Fifteenth Report of the Committee appointed for the purpose of Investigating the Circulation of Underground Waters in the Permeable Formations of England and Wales, and the Quantity and Character of the Waters supplied to various Towns and Districts from these Formations.

Rep. Brit. Ass. for 1889, p. 71.

This report gives details of borings put down at various times, most having been previously published, into the Triassic rocks from Dartmouth to Durham. The details are in answer to printed questions, which are numbered, and the numbers corresponding are given in this report, but not the questions, without which much of this report is unreadable. The following are the wells and borings detailed:—

Combe Vale, N.W. of Teignmouth, 1887 (published), section of pebble beds given.

Burcot Pumping Station, East Worcester, 1881. No section, but three analyses of the water are given, taken 1881 and 1887.

Charford, near Bromsgrove. Analyses of the waters in 1887.

Upper Keuper Sandstone, at Leicester, shows drift 15 ft.; Upper Keuper Marl, 35 ft.; Upper Keuper Sandstone, 41 ft.; Red Marl, 40 ft.

Davis & Co., manufacturers, Leicester, shows drift 20 ft.; Upper Keuper Marls, 25 ft.; Upper Keuper Sandstone, 45 ft.; Red Marl, 60 ft.

Raven & Co., Leicester, shows drift 8 ft.; Upper Keuper Marl, 55 ft.; Upper Keuper Sandstone, 42 ft.; Red Marl, 99 ft.

(Bourn, Lincolnshire—passed through Shelly Limestone, obviously not Triassic.)

Liverpool. Further details are given of a boring already recorded, viz., the following partial analyses by Campbell Brown, of A, from 700 ft.; B, from 1,180 ft.; and C, from 1,280 ft.

		A	B	C
Sand and insoluble matter	..	95·16	94·20	86·72
Alumina and oxide of iron	..	0·86	1·94	2·66
Lime	..	1·15	1·03	4·74
Magnesia	..	0·88	0·36	0·82
Carbonic acid combined	..	1·43	1·00	4·30
		99·48	98·53	99·24

Halewood, near Hunts Cross, 1882, shows Clays and Sands, 138 ft.; Red Marl, 276 ft. These have been analysed, and it is stated the average amount of oxide of iron and alumina in marls of Permian age is 3·6 per cent., and in those of Keuper age is 13·4.

Eccleston Summit; Goatacre Bridge; Childwall Valley, 274 ft., all in Pebble beds, with many beds of Marl.

Portico Lane Bridge, east of Prescot, gives 366 ft. of Red Sandstone with two bands of Red Marl. At 54 ft., the rock contains 3·46 Iron and Alumina, 9·90 Calcium Carbonate, 0·91 Magnesia, and 83·89 of insoluble matter. This may either be Lower Red Sandstone or Permian, as at Bootle.

Goatacre Station shows 435 ft. of Pebble beds lying directly on Coal Measure Shales.

Kirby, St. Helens, gives 352 ft. of Pebble beds and 108 ft. of Red Sandstone below.

Knowsley gives 687 ft. of Red Sandstone, with one band of Marl near the top.

From Yorkshire and Durham the well-known salt borings are given, as at Greatham and Seaton Carew. A second, half a mile north-west of Seaton Carew, not mentioned by E. Wilson (Q.J.G.S., Nov., 1888), gives 225 ft. of Red Sandstone, with Marl; 390 ft. Red Marl, with a little Sandstone; 18 ft. 6 in. Anhydrite; 28 ft. 6 in. Red Marl; 77 ft. 6 in. Anhydrite, and 40 ft. Limestone.

Appendix II. gives H. G. Fordham's results in chalk wells, noted elsewhere, and III. selects some Hampshire well sections previously published.

[**200.**] **Worth, R. N.**—Additional Notes on the Cornish Trias.

Paper read to the Royal Geological Society of Cornwall in November, but not published in 1890.

201. Worth, R. N.—Further Notes on the Existence of Triassic Rocks in the English Channel, off the Coast of Cornwall.

Abstract in Proc. Geol. Soc., p. 120.

Fragments of a breccio-conglomerate are trawled up 7 miles south of Deadman Headland, and several miles east of the Lizard outlier of such Triassic rocks. It was probably *in situ*, and nearly horizontal. The materials of the pebbles are slate, grit, vein quartz, quartz felsite, andesite, and rhyolite.

202. Worth, R. N.—The Igneous Constituents of the Triassic Breccias and Conglomerates of South Devon.

Q.J.G.S., vol. xlvi., p. 69.

From the history of previous opinion, it is seen that the local origin of many of the pebbles in these conglomerates has been doubted, and, in particular, whether any or many have been derived from the Dartmoor granite. The author, therefore, gives a detailed description of the principal varieties amongst some hundreds or thousands of examples. The size of the blocks is greatest at Teignmouth, where some of them are 4 or 5 ft. in diameter. The next in size, up to 4 or 5 inches, are seen at Exminster, where many are granitoid; and there are also many of the same kind near North Tawton and round the north of Dartmoor. He divides the different varieties as follows:—I. Granites. Of these he gives an example of a coarse grained form, and of a fine grained form from Exminster, both identical with the Dartmoor granite, and the sand and fine material from Exminster and Heavitree is also very granitoid in composition. II. Felsite group, divided into (*a*) non-schorlaceous. Of these he gives 29 examples from Teignmouth, Dawlish, Torbay, Exminster, Heavitree, and Crediton, and states that some, "save in colour, are hardly distinguishable from some Dartmoor elvans;" some, however, show flow structure, or are vesicular and spherulitic. (*b*.) Schorlaceous. Of these he mentions 19, from Exminster, Teignmouth, and Heavitree. III. Andesitic group. These range between Andesites and Basalts, and "in many cases present no distinctive characters from some of the varieties *in situ*." He mentions 14 examples from Torbay, Teignmouth, Exminster, and Heavitree, five of which he identifies with particular rocks *in situ*. IV. Miscellaneous. These are vein stones, schorl rocks, schists, and altered slate, in all amounting to 10 varieties. The only examples amongst all these that show any material divergence from existing Devonian rocks, are the spherulitic felsite, the greenish rhyolite, and "the vesicular felsite with a horny base." These are more open or porous in character.

The huge size and often angular character of the fragments suggests high land in the neighbourhood. The existence of felspathic traps in the Trias, shows the nearness of a volcanic vent. These traps are in part antecedent to

the Trias, as their fragments are found in it, and partly contemporaneous, as they overlie and alter the Trias in places. They are also cut by felsitic dykes. No rocks now seen *in situ* could have yielded these fragments of felspathic traps. He concludes that the granite of Dartmoor must, in Triassic times, have passed upwards into felsites, rhyolites, and volcanic rocks. In other words, Dartmoor must be the base of a volcano of not earlier than Permian times.

203. Clowes, F.—On Barium Sulphate in Water-box Deposits from the Durham Coalmine Waters and in Nottingham Sandstone.

Rep. Brit. Ass. for 1889, p. 594.

The principal results had already been published, but complete analyses have now been made:—

	Hemlock Stone.		Stapleford Hill.		Bramcote Hill.	
	Top.	Base.	Top.	Base.	Pebbles at top.	Middle.
Alkalis and loss	2·38	3·90	1·60	1·83	3·65	3·36
Iron and alumina ...	6·41	4·84	3·53	4·46	5·10	4·45
Baryta	30·23	21·89	30·81	32·80	18·52	33·30
Lime	—	1·68	0·02	—	—	—
Magnesia	0·13	1·08	0·10	—	—	—
Sulphuric Acid	16·39	12·09	16·58	17·14	10·14	17·42
Silica	44·46	54·52	47·36	43·77	62·59	41·47

The baryta at Beeston Castle is in the form of carbonate. Similar substance, *i.e.*, Barium Sulphate, is precipitated in the colliery pipes in Durham, and he thinks in both instances it may be produced from the carbonate by the reaction of soluble percolating sulphates.

204. Beasley, H. C.—The Life of the English Trias.

Proc. Liv. Geol. Soc., vol. vi., part ii., p. 145.

This gives a general summary of the fossils which have been found in the Keuper. *Dipteronotus cyphus* is spoken of as from the Bunter, but, as is acknowledged, without authority. On some large slabs near Warwick, pointed out by Wm. Brodie, and also on some slabs in Bootle Museum, are some impressions where *Cheirotherium ?* sat down on his haunches, covered with an armoured integument. The following local museums possess noteworthy Triassic Fossils: Bath Royal Institution, Bristol, Bootle Free, Chester Grosvenor, Elgin, Edinburgh Science and Art, Exeter, Leicester Town, Liverpool Free, Nottingham Free, Newcastle-on-Tyne Nat. Hist. Soc., Shrewsbury Free, and Warwick.

205. Reade, T. M.—Cause of the Colouration of Red Sandstone.

"The Naturalist," p. 1.

He has seen some blown sand in a dune, coloured like the Trias, by an iron nail lying on the surface and corroding, and

concludes that the red coating of the Trias Sandstones is subsequent to their deposition.

206. Reade, T. M.—The Physiography of the Lower Trias.

Rep. Brit. Ass. for 1889, p. 566.

Printed *in extenso* in the Geological Magazine for December, 1889. The gist of it is that the Bunter is in hollows, below the 400 ft. contour line, and has been formed by tidal action in straits, seas, and bays, and may have been derived from a granitic area in the English Channel, from the Old Red Sandstone along the Mendip axis, and in Herefordshire, and from the Carboniferous Sandstone of the Pennine Chain. The quartzite boulders have come from the south, being smaller and fewer in Lancashire than near Market Drayton.

207. Bonney, T. G.—Mr. Mellard Reade's Interpretation of the Lower Trias Physiography.

Geol. Mag., Dec. 3, vol. vii., p. 52.

This is a contribution to the controversy as to the marine or fluviatile origin of the Bunter. He first notices the objections to the fluviatile theory. 1. The distribution of the Bunter. This seems to him to present no great difficulty [though, in reality, it is the main one, especially as taking the series out of comparison with the Alpine Nagelflue, which is a very local deposit, changing its character from spot to spot, so that one part is called the "Bunte nagelfluh" another the "Kalk nagelfluh"] 2. The absence of any Triassic river channel, which he does not expect. 3. The absence of anything but sand and pebbles. He here again refers to the Molasse and Nagelfluh of Switzerland, whose "resemblance to the Trias points to similarity of origin." [This does not seem to help us much, as "by far the larger portion of these strata is of lacustrine origin,"* and such an origin is denied by both controversialists for the Bunter] 4. The disappearance of the high range whence the pebbles were derived. The author asks, what of Scotland? from which source we may therefore suppose the pebbles, on his theory, must have come.

He then raises his own objections to the marine theory. 1. He doubts if marine currents could carry stones 4 in. in diameter. 2. He asks where the Triassic estuary communicated with the ocean, and thinks the river might escape by a narrow gorge [but does not say where that gorge was]. 3. He knows no evidence of marine conglomerates being formed. [Certainly the Bunter is an exceptional deposit, and such cannot be always forming.]

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* Geikie, "Text Book of Geology," p. 860.

He lastly draws attention to overlooked facts. 1. The resemblance to the Nagelfluh. This has been already mentioned. 2. The origin of the Bunter Pebbles. This he regards as no longer an open question—other views than his own being "hypotheses," his own being an "induction from facts." There are, besides the quartzites: granites, gneisses, various felstones, and quartz felspar grit. These he considers to resemble Scotch rocks more than any others, and the quartzite pebbles themselves to be unlike any known quartzite except that of N.W. Scotland. The conclusion is that the Bunter has been derived from Scotland. [This theory confessedly leaves several opposed facts unexplained; and it is not easy to understand why the rocks of N.W. Scotland should leave their relics only in England. The whole controversy seems to depend on the assumption that the pebbles are derived from rocks in mass, whereas there are the Cambrian and Old Red Conglomerates, which may have been the chief contributors of the pebbles.]

208. Reade, T. M.—Physiography of the Lower Trias. Geol. Mag., Dec. 3, vol. vii., p. 185.

This is a reply to two of the points raised by Prof. Bonney's paper, above. 1st. The possibility of the Pennine Chain having formed a boundary between two rivers flowing south. The principal point is that, in Lancashire and Cheshire, there are scarcely any conglomerates, and the so-called pebble beds have often no pebbles. The great masses of conglomerate are further south in the Midlands. This indicates that the Midlands are nearer the source. 2nd. The power of tidal currents to move large pebbles. Their power is fully detailed in two papers. "Tidal Action as a Geological Cause," Proc. Liv. Geol. Soc., 1873-4; and "Tidal Action as an Agent of Geological Change," Phil. Mag., 1888; and they are there shown by known facts to be amply sufficient to carry the Bunter pebbles.

209. Hunt, A. R. (Geol. Mag., Dec. 3, vol. vii., p. 191), says that tidal currents can have no power, because in such a favourable place as the English Channel, sand and mud and the accompanying fauna are not washed away, and refers to Delesse "Lithologie du Fond des Mers" in proof. [The map, however, in that work proves the contrary, for there is a great sketch of the channel bottom between Brittany and England with naked rock, all the gravel, &c., having been cleared off.

210. Jukes-Browne, A. J.—The Physiography of the Lower Trias.

Geol. Mag., Dec. 3, vol. vii., p. 220.

Generally discusses the arguments on either side. The strong points against the fluviatile theory are:—1. The uni-

versal sandiness of the Bunter. 2. The Trias of the Vale of Clwyd, which opens northerly. 3. The greater thickness of the pebble beds in the south. Three points against the marine theory are:—1. The feebleness of currents, on which he states that the valley-like trench in the Irish Sea, considered to have been scoured by the tidal current, is thought by many to be an ancient submerged valley. 2. The question of the communication to the open sea; and 3. The difficulty of such thick pebble beds being accumulated on a sea floor. He asks why the pebbles should not have been derived from some still older conglomerates, "the remnants of which are now concealed from view"? [Can they, however, be said to be concealed, when so much is seen in the Longmynd?]

211. Bonney, T. G.—Mr. Mellard Reade on the Physiography of the Lower Trias.

Geol. Mag., Dec. 3, vol. vii., p. 235.

Replies [to No. **208**] that he knows that Staffordshire conglomerates are confined to a considerable area of the Midlands, but cannot explain them on the marine hypothesis [neither *does* he on the fluviatile], and acknowledges that the thick sandstones of Cheshire are in like case. He now says that he doubts the power of tidal currents, "under the physical conditions of the English Trias." [It is not easy to understand this proviso, as] the author now says there must have been an elongated gulf, with a narrow and shallow entrance; while before he said: "the estuary should be pretty deep." The author twits Mr. Reade on his "limited experience," because he is not acquainted with the Nagelfluh [but perhaps one of the greatest difficulties of the fluviatile theory would be, to account by its means for the strong resemblance of our English Bunter to the huge pebble beds of the German Bunter as seen at Eisenach]. The author now says he cannot find the pebbles "either *in situ* or in older conglomerates" in the southern half of England. Previously, only rocks *in situ* were referred to.

212. Reade, T. M.—Physiography of the Lower Trias.

Geol. Mag., Dec. 3, vol. vii., p. 260.

He here gives further details in proof of the power of tides. The channel scooped out opposite Wigtownshire is in exact parallelism with the stream tide lines. There is another deep opposite and north of Rathlin Island of 798 ft., the surrounding sea bottom being only 60—80 fathoms, and there is bare rock at a depth of 630 ft. "A clear proof that the deep has been excavated." [We must suppose he means, not the solid rock, but the mud or gravel that would inevitably accumulate upon it]. Hind Deep, opposite the Casquets, is 570 ft. deep, and has bare rock at 438 ft., the surrounding bottom being only about 200 ft. deep. He then points

out that the 2,000 ft. of Trias at Carrickfergus, and its height of 1,200 ft. above the sea on Slieve Gallion, show that we cannot easily restore the physical geography of the period. In the Vale of Clwyd, there are no pebbles, only much current bedding, which is just what we should expect in a tidal *cul-de-sac*.

213. Stirrup, M.—Wind Waves and Tidal Currents.

Geol. Mag., Dec. 3, vol. vii., p. 430.

Quotes a statement by **M. Fol** ("Revue Sci.," June 7, 1890) that, in diving, he has felt the motion of the sea strongly at 100 ft. down, and that, after a storm, the banks at 164 ft. down are swept clear, and this is in the Mediterranean, where the tides are feeble.

RHÆTIC AND LIAS.

214. Ussher, W. A. E.—The Geology of Parts of North Lincolnshire and South Yorkshire.

Memoirs Geol. Survey, chaps. iii.—vii.

Chapter III.: Black Rhætic shales are seen between Blyton Station and Blyton, at a pond between Hardwick Warren House and Scotterwood, in a ditch south of "oo" in Middlemoor, where *Estheria minuta*, *Myophoria postera*, and *Saurichthys acuminatus* have been obtained. The rest of the evidence given is less direct.

Chapter IV.: The Lower Lias beds are massed in three divisions :—

Clays	Zone of *Am. capricornus* to ,, ,, *Am. oxynotus*.
Frodingham Ironstone..	,, ,, *Am. semicostatus*.
Clays and Limestones..	,, ,, *Am. Bucklandi*. ,, ,, *Am. angulatus*.
with	
Basement beds	,, ,, *Am. planorbis*.

Two localities only show fossiliferous beds of the *Planorbis* zone. South of Messingham Mill, an outcrop yielded *Modiola minima*, *Ostrea liassica*, and *Pleuromya crowcombeia* [Infra-ammonitiferous zone]. At a quarter of a mile south of Scotterwood, a dark grey limestone yielded *Lima gigantea*, *Modiola minima*, *M. pygmæa*, *Cerithium semele*, *Eucyclus Chapuisii*, and young Ammonites [Ammonitiferous zone].

The information about Clays and Limestones is very meagre. In the Frodingham railway cutting are seen about 110 ft., about which nothing is practically said. The most northerly point at which beds in this horizon are seen is at a quarry opposite Whitton Pier. About half a mile north of Burton Church, a 15 ft. cliff is seen, and about 50 ft. lower *Am. angulatus* was obtained. Between Brumby Wood and

Yaddlethorpe are several pits, and between Brumby and the Ferry is a large pit, showing more than 20 ft. in thirteen divisions. *Am. angulatus* was found in a loose fragment. Other pits are seen south of Messingham. None of these places, nor others that are mentioned, appear to have been searched for fossils, as none beyond the inevitable *Gryphæa incurva* are given, and there is little beyond their surface position to show to what part of the series they belong. Mr. Cross's list of fossils is quoted.

The Frodingham ironstone is mapped separately. Its description is borrowed from published sources; but the following additional fossils have been obtained:—*Cardinia ovalis, Plicatula spinosa, Lima pectinoides, Pecten æquivalvis, P. textorius, Plumaster ophiuroides ?* Exposures are traced and noted at the following, with others: Half a mile N.W. of Coleby Hall, fossiliferous ironstone has been dug; between Coleby and West Halton is a pit showing 6½ ft., and another showing 8½ ft.; near Normanby Grange, showing 6 ft.; places round Normanby Park; a long pit half a mile north of Rannelow Farm. In the Northorpe district, the Frodingham beds no longer present distinctive lithological characteristics, but the evidence is mostly obtained from ditches and waterlogged pits. The thickness of the ironstone at Frodingham is estimated at 30 ft. The fossils obtained at all the exposures except the quarries at Frodingham are:—

Gryphæa arcuata.	Ammonites semicostatus.
——— Maccullochi.	Cardinia Listeri.
Pecten liasinus.	Pholadomya ambigua.
Unicardium cardioides.	Lima gigantea.
Pecten æquivalvis.	

The clays above the ironstone are mostly only seen near their junction with the overlying Pecten Bed, but they have a thickness of over 90 ft. At the east end of the great quarries towards Gokewell Common, the basal 4 ft. is seen, but no fossils have been obtained. Localities for the upper part are half a mile from Bagmoor and between Normanby Park and High Risby, where nodules in the clay are fossiliferous. There are many pits between Gokewell Stream and the road to Ashby, between the roads to Bottesford and Messingham, and between the latter and the railway. There is also a large pit one mile E.N.E. of Northorpe Station. From these various pits the following fossils are recorded:—

Rhynchonella tetrahedra.	Pecten liasinus.
Terebratula punctata.	Hippopodium ponderosum.
Spiriferina Walcottii.	Plicatula spinosa.
Lima gigantea.	Modiola scalprum.
—— pectinoides.	Pholadomya ambigua.
—— antiquata.	Pleuromya æquistriata ?
Crenatula ventricosa.	Unicardium cardioides.
Avicula inæquivalvis.	Ammonites capricornus.
Pecten æquivalvis.	——— latæcosta.

[These, with others recorded by J. E. Cross, appear to belong to zones from *Armatus* to the base of *Capricornus*, *i.e.*, to the Middle Lias.]

Chapter V. discusses the junction between the Middle and Lower Lias. It appears that the Pecten bed has abundant *Am. Henleyi*, the clays above abundant *Am. capricornus*, and that there is no *Am. margaritatus* to be found, and that *Am. armatus* has been recorded from the Pecten bed. These facts and their bearings are discussed from various points of view, and "on the whole" he is "strongly inclined to regard the Pecten bed as the base of the Middle Lias." [There really seems nothing abnormal here; above the clays last mentioned belonging to the *Jamesoni* series, come naturally the *Henleyi* beds, which are the base of the *Capricornus* series. Then follows the rest of that series—the zone of *Am. margaritatus* has merged in that of *A. spinatus*, as it often does, and thus the true base of the Middle Lias is little, if anything, above the Frodingham ironstone.]

Chapter VI.: The Pecten Bed Ironstone. This has a thickness of about 4 ft., and is characterised by the abundance of *Pecten cf. sublævis*: it is a ferruginous limestone. Good exposures are seen in a ditch half a mile west of Roxby, on the slope of Sheffield Hill, at "rr," in Crosby Warren, in the road from Scunthorpe to Appleby Station, on Manby Common, Twigmoor Warren, and between this and Messingham. The other localities seem less satisfactory. The fossils obtained from one or other of these are:—

Rhynchonella tetrahedra	Cypricardia intermedia.
Gryphæa gigantea.	Tancredia ovata.
——— cymbium.	Modiola scalprum.
Pecten æquivalvis.	Pleuromya unioides.
——— liasinus.	Unicardium globosum.
——— æqualis.	Pholadomya ambigua.
Lima antiquata?	Gresslya lunulata.
Cardinia Listeri.	Ammonites striatus [Henleyi].

The overlying clay contains fossiliferous nodules, and is estimated at about 67 ft., and has been exposed from top to base in the railway cutting between Appleby and Frodingham. The present exposures are one mile west of Appleby Station, ten chains north of Manton Warren House, a quarter of a mile N.N.W. of Cheatham Grange, and west of Mount Pleasant. The fossils obtained are:—

Ostrea irregularis.	Hippopodium ponderosum.
Avicula inæquivalvis.	Pholadomya ambigua.
Pecten æqualis.	Ammonites capricornus.
Lima pectinoides.	Belemnites acuarius.

The Marlstone Rock bed is 5 to 8 ft. thick, and contains abundance of *Rhynchonella tetrahedra*. It is exposed at Santon Warren, near Daw's Pit, one mile west of Appleby

Station, near Readings Wood, 66 and 15 chains north from Manton Warren House, ¼ mile N.N.W. from Cheatham Grange, ¼ mile south of Cheatham, ¼ mile S.W. from Mount Pleasant. The following fossils have been observed by the Survey :—

* Rhynchonella tetrahedra.	Belemnites acuarius.
* Terebratula punctata.	———— acutus.
* ———— Edwardsii.	* ———— breviformis.
Pecten æquivalvis.	———— clavatus.
——— textorius.	Ditrupa etalense.
Avicula inæquivalvis.	

No recognisable ammonites have been observed in it, but Mr. Cross recorded *Ammonites spinatus* from the lower part, and *Am. communis* and *Am. serpentinus* from the upper. North of the Humber, the best exposure is in the Everthorpe railway cutting, and from near Ellerker the fossils marked * above have been obtained.

Chapter VII.: Upper Lias. This consists of bluish grey shales, with thin lenticular limestone patches, and is estimated at about 26 ft. Its exposures are mostly near its junction with the Dogger. They are two clay pits north of Crossby Warren, ½ mile west of Low Stanton Farm, between Manton Warren House and Manton, and best of all the cutting between Kirton Station and the tunnel. The remainder, and all those north of the Humber, appear to be in various sinkings. The fossils recorded are :—

Terebratula punctata.	Ammonites serpentinus.
Discina reflexa ?	———— communis.
Lima pectinoides.	———— elegans.
Pleuromya unioides.	———— semicelatus.
Eucyclus imbricatus.	Belemnites vulgaris.

[It appears probable that some of the fossils from the several zones may be doubtfully determined.]

215. Browne, M.—A Contribution to the History of the Lias and Rhætics of Leicestershire.

Trans. Leicester Lit. and Phil. Soc., vol. ii., pt. iii., p. 147.

The Rhætics have been traced at several points round Barrow-on-Soar, together with the overlying zones, up to the *Bucklandi*.

216. Quilter, H. E.—Trans. Leicester Lit. and Phil. Soc., vol. ii., pt. iii., p. 147.

Records: *Psiloceras intermedius*, *Arietites rotiformis*, and two specimens of a new *Psiloceras* or *Ophioceras* from the Lias of Barrow-on-Soar.

217. Stock, T.—Science Gossip, 1890, p. 189.

He has found remains of a large *Ichthyosaurus* in the Lower Lias between Lilstock and Stolford—15 vertebræ, also *Nemacanthus* in the bone bed there.

218. Hey, W. C.—Exposure of Lower Lias at Redcar.

" Naturalist," p. 149.

After a storm on April 8, the low cliff at the east end of Redcar was bared and several feet of Lias with *Gryphæa arcuata* were exposed.

219. S. A. A.—Scientific Aspects of Health Resorts. IX., Saltburn and district.

"Research," vol. ii., p. 148.

A general description, with reproductions of photographs of Huntcliff, and the cliffs at Staithes, and near Marske Mill.

220. Buckman, S. S.—On the so-called "Upper Lias Clay" of Down Cliffs.

Q.J.G.S., vol. xlvi., p. 518.

Below the yellow sands called Yeovil Sands, are 70 ft. of blue micaceous shale, hitherto referred to the Upper Lias; but 12 ft. from the top he has found impressions or casts of Ammonites often crushed, which he refers to *Dumortieria radians* and *D. Levesquei.* These are characteristic of his "*Dumortieria* zone," which occurs in the Cotteswolds, *above* the Cotteswold sands. He concludes, therefore, that these marls are only an argillaceous form of the overlying Yeovil Sands; and though the "*Dispansum, Striatulus,* and *Variabilis* beds" are not yet recognised, he has found in the 10 ins. of cream-coloured limestone, which is incorporated in one block with the marlstone, "*Hildoceras bifrons*" in the upper portion, and "*Harpoceras falciferum*" in the lower, and these 10 inches he therefore takes to represent the true Upper Lias, and contends that this conclusion is consonant with the ammonite distribution in the neighbourhood. He sees in these facts a fresh proof of the necessity of separating the Upper Lias and the Lower part of the Inferior Oolite to form a "Toarcian" group. In the discussion, H. B. Woodward stated that *A. radians* and *A. striatulus* occur with the ordinary characteristic species in the basement beds of the Upper Lias from Dorsetshire to Lincolnshire—and that the author would thus abolish the Upper Lias throughout the country. [This may be so, yet the two species mentioned are characteristic of beds *above* the *ordinary* Upper Lias.]

221. Thompson, Beeby.—The Upper Lias of Northamptonshire, part vi.

Journal Northamptonshire Nat. Hist. Soc., vol. v., p. 54.

This part deals with the *Leda ovum* beds, which he divides into three parts. The Lower are also called the *Cerithium* beds, from the abundance of *Cerithium armatum,* with a large number of other gasteropods. The characteristic Ammonites are Stephanocerata, viz., *A. fibulatus, A. Desplacei,* and *A. semicelatus.* Exposures are noticed at Thorpe Mandeville, Wappenham, Heyford, Brington, Hunsbury Hill, Vigo, Half-

way House, Spratton, Creaton, Castle Ashby, Wellingborough, Finedon, and Higham Ferrers. Each of these has a list of fossils there obtained appended.

The Middle beds have no fossils peculiar to them [see, however, the list below], but their fauna is divided between the Upper and Lower. Exposures of these are noted at Eydon and Farndon, Badby, Easton Neston, Naseby, Northampton, Higham Ferrers, and Irthlingborough.

The Upper part is also called the "*Jurensis*" zone. The line between Oolites and Lias is here well marked, and if the horizon of the Midford Sands is to be recognised, it must be found in the Lias shales, and not in the Oolite, which belongs to the "*Opalinus*" zone. He states that "a very considerable unconformity ' does not exist; but, later on, that the Upper Lias may have been denuded before the deposition of the Inferior Oolite. He believes, however, that the Northampton sand has slipped over the modern outcrop of the Lias and produced a false junction. [The members of the Geologists' Association, directed by this writer, saw: 1. The Northampton sands lying on different parts of the Lias in different pits; 2. An erosion in inclined beds of Lias, filled with horizontal Northampton sand, curving to the boundary in Vigo brickyard; 3. Lias nodules, already indurated, coated with serpulæ and bored by lithodomi before the deposition of the oolite—three pieces of evidence that could leave no doubt of the erosion of the Lias.] Some of the fossils in these clays have the names of Oolite species attached. [Possibly the identification of the casts may be deceptive.] Although these beds are correlated to the *Jurensis* beds, that ammonite has not been found in them [nor would it very possibly be in an equal exposure in Yorkshire], nor yet *A. communis*. [One specimen has, however, been reported to have been found]. Exposures of this portion are noted at Green's Norton, Long Buckby, Moulton, Wellingborough, Hill Top, and Kettering. The most important of these is at Moulton, where he states that the two formations seem to be quite conformable; [but where the coated nodules prove erosion, and the *Lithodomus* and *Serpula* are Oolitic and not Liassic fossils].

The list of fossils shows the following species common to all these divisions:—

Phylloceras heterophyllum.
Harpoceras lythense.
———— exaratum.
———— bifrons.
Belemnites vulgaris.
———— elongatus.
———— subaduncatus.
Euomphalus minutus.
Inoceramus dubius.
Myoconcha elongata.
Astarte lurida (not in Middle).
Arca elegans.
Leda ovum.
Cardinia opalina.
Lucina bellona.

The Lower beds contain, in addition, the following fauna, those with * occurring also in the Middle:—

Nautilus striatus.
——— jurensis.*
——— astacoides.*
Stephanoceras Holandrii.*
——— Braunianum.
——— crassum.*
——— semicelatum.
——— Desplacei.
——— fibulatum.*
Harpoceras simile.*
Belemnites breviformis.
——— irregularis.
Dentalium liassicum.
——— elongatum.
——— spec. nov.
Phasianella turbinata,
Turbo latilabrus.
Turritella Dunkeri.
Cerithium armatum.
——— varicosum.
Cerithium costellatum.
——— costulatum.
——— ibex ?
——— paludinare ?
——— seminudum
Chemnitzia semitecta,
——— transversa.
Acteonina ilminstrensis.
——— marginata.
——— decoratum.
——— secale.
Pecten pumilus.
——— subpunctatus.
Avicula imbricata.
Cucullæa elongata.
Nucula Hammeri.
Gresslya donaciformis.
Lingula longovicensis.
Discina reflexa.*

The Middle beds contain the following exclusively:—

Stephanoceras subarmatum.
——— spec. nov.
Belemnites ventralis.
Thracia glabra.
Pleuromya rotundata.
Magila parvula ?
Meyeria ? polita.
Peneus Sharpii.

The Upper beds contain, in addition, the following, none occurring in the Middle only:—

Lytoceras cornucopia.
——— rubescens.
Harpoceras falcifer.
——— lympharum.
Belemnites subtenuis.
——— crossotelus.
——— athleticus.
——— compressus.
Dentalium gracile.
Trochotoma calyx.
Purpurina ornatissima.
Ostrea sandalina.
——— falciformis.
Pecten demissus.
——— cingulatus.
Lima toarcensis.
Monotis Münsteri.
——— substriatus.
Inoceramus lævigatus.
Mytilus gregarius.
——— cuneatus.
Lithodomus Porteri ?
Macrodon intermedius.
Cucullæa cancellata.
Trigonia Northamptonensis.
Astarte minima.
Corbis uniformis.
Protocardium substriatulum.
Goniomya angulifera.
Gresslya abducta.
Pleuromya decurtata.
Quenstedtia lævigata.
Lingula Beanii.
Serpula conformis.
Pentacrinus jurensis.
Diastopora stromatoporoides.

Arguing on these facts, the writer concludes these Upper beds to belong to the "*Jurensis*" zone on account of the change of fauna, which is emphasized when the numbers as well as the species are considered, the presence of the characteristic *A. lympharum* [=*A. lectum*, Simpson] and the [almost] entire absence of *Stephenocerata*, their place being taken by addition *Harpocerata* and *Lytocerata*.

The paper concludes by notes on the species, four of which are considered new. (*See* **Invertebrate Palæontology.**)

222. Buckman, S. S.—On the Jurense Zone.

Extract from Jour. Northamptonshire Nat. His. Soc., vol. v.

He calls all the strata which lie between the *Opalinum* zone and the *Commune* zone by the name of *Jurense* zone [notwithstanding the fact that he records that species only from the lower part of the series].

This zone he divides into the following in descending order:—

Dumortieria beds	Dumortieria radians.	Catulloceras Dumortieri.
	——— Levesquei.	——— Leesbergi.
	——— costula.	Huddlestonia affinis.
	——— striatulo-costata.	——— serrodens.
		——— sinon.
	———pseudoradiosa	
Dispansum beds	Grammoceras dispansum.	Grammoceras Doerntense.
	——— fallaciosum.	——— metallarium
	——— Orbignyi.	Polyplectus discoides.
	——— Sæmanni.	Hammatoceras insigne.
	——— Mulleri.	Haugia illustris.
	——— quadratum.	
Striatulum beds	Grammoceras striatulum.	Haugia occidentalis.
	——— toarcense.	Pseudolioceras compactile.
	Haugia Eseri.	Lytoceras jurense.
Variabilis beds	Haugia variabilis.	Lytoceras sublineatum.
	——— jugosa.	Pseudolioceras compactile.
	——— Dumortieri.	

These divisions may be best studied in the Cotteswolds. In other districts, the lithology is different; in Yorkshire, the three lower zones are a dark black rock [he means dark shales], the upper one is the "yellow and grey sands." In Gloucestershire, the *Variabilis* beds form three-fourths of the Cotteswold sands, and the others are marly oolitic limestones. In the Bath district, no *Variabilis* or *Dumortieria* beds are known. The *Falciferum*, *Commune*, and *Striatulum* beds are contained in one of these seams, and the *Dispansum* beds are the Midford Sands. In the Ilminster district, the three lower zones are contained in 6 ft. of marly clay and limestone mixed—like the matrix of the zones below. The *Dumortieria* beds are the lower part of the Yeovil sands. In the Down cliffs, *Grammoceras striatulum* is found in the "junction bed," and *Dumortieria* occurs in the 70 ft. of overlying clay, and passes into the sands above. [Unless these statements are proved and explained, and the accompanying fauna studied, they seem like a *reductio ad absurdum* of Ammonite zones.] With regard to Northamptonshire, he does not admit that the Upper *Leda ovum* beds represent the *Jurense* zone, as they do not contain the species above recorded as characteristic,

but do contain species of the *Commune* and *Falciferum* zones. He does not attempt to deal with the rest of the fauna.

223. Thompson, Beeby. — The Jurensis Zone in Northamptonshire.

Journal Northamptonshire Nat. Hist. Soc., vol. v., p. 96.

He replies to the above that *Am. bifrons* and *Am. cornucopia* have in France a range throughout the whole Upper Lias, including the *Jurensis* zone, and that *Am. lympharum* and *A. Lilli* (a new record) are characteristic of that zone. [There can be no doubt that a new fauna, many of whose members are characteristic *Jurensis* fossils, sets in with the Upper *Leda ovum* beds, to which the above quoted ammonites are *indices*, but as there is erosion between these and the Oolites, and many of the characteristic *Jurensis* fossils are as yet unknown there, only the lower part of the zone is left.]

[**224**]. **Walker, J. F.** — On Liassic Sections near Bridport, Dorset.

Paper read to the British Association on Sept. 4, but not published in 1890.

THE OOLITES.

[**225.**] **Benney, A. E.**—The Oolitic System.

Paper read to the Bradford Naturalists and Microscopists' Society on March 10, but not published in 1890.

226. Solly, H. S.—The Geology of Bridport.

Proc. Dorset N. H. & F. C., vol. xi., p. 109, with a plate.

The plate is from Woodward's Geology of England and Wales, and the account is an explanation of it.

227. Solly, H. S., and Walker, J. F.—Note on the Fault in the Cliff West of Bridport Harbour.

Proc. Dorset N. H. & F. C., vol. xi., p. 118.

In one case the Midford Sands is faulted against the upper part of the same deposit, the Inferior Oolite coming on immediately on the downthrow side. In another, an apparently single bed of Fuller's Earth is really a faulted continuation—one-half containing numerous fossils belonging to the Inferior Oolite, the other few, but different ones, and probably of Great Oolite age.

228. Seward, E.—A Slab of Fossiliferous Marble from Marston Magna.

Trans. Cardiff Nat. Soc., vol. xxi., pt. 1., ? 1890. Not seen.

229. Harker, Allen.—On the Sections in the Forest Marble and Great Oolite Formations exposed by the new Railway from Cirencester to Chedworth.

Proc. Cotteswold Nat. F. C., vol. x., p. 82.

Leaving Cirencester, the first, "Norcote" cutting is in Forest Marble, with the "Marble" well shown; the next,

" Burford Road," is in thin banded sands and clays on a lower horizon; the third, the "Wiggold approach" cutting, near the bottom of the Forest Marble; the fourth, or "Wiggold" has fissile slates and fine-grained "Great" oolite, and there are many pipes with sandy *débris* [? Westleton beds—this is about 500 ft. up]; the "Stow Road" cutting with thinner oolites, one with corals and one shelly, like Forest Marble. The next two small cuttings are still in oolites. "Folly Barn" cutting shows marls, separated by a *lenticular* oolite band. In the "Aldgrove" cutting are *two* "perforated" beds, furnishing the ornamental "Dagham" stone, previously supposed to be in one bed only. In the lowest freestone are some round balls with concentric shells and stromatoporoid structure. In the highest—"Stony Furlong"—cutting, at 637 ft., are compact oolites with three "perforated" bands and many fossils. Then, after a fault, a more marly series, at the bottom of which a thin clay bed with bivalve shells and 10 per cent. of organic matter. The "Chedworth" cutting is in oolitic "Fuller's Earth" with *Ostrea acuminata*, and the tunnel is in the clays of the same.

230. Buckman, S. S.—The Sections Exposed between Andoversford and Chedworth—a Comparison with Similar Strata upon the Banbury Line.

Proc. Cottsw. Nat. F. C., vol. x., p. 94.

Nearest Andoversford (second cutting), sandy oolite is seen overlying Pea grit with [*Am.*] *Murchisonæ*. These, the "Syreford Sands," are therefore below and not above the Freestones, like the "Harford Sands." The third cutting shows an anticlinal. In it, in descending order, are: 1. Pea grit limestone; 2. Marly limestone, 3 ft.; 3. Yellow sandy limestone with *R. cynocephala* and *Belemnites*. This represents the *Opalinum* zone and Frocester cephalopoda bed. 4. Brown and blue sands, 5 ft., represent all the Cottswold sands; 5 is referred to the Lias. At Withington it is all clay. In the eighth cutting, new beds occur, *i.e.*, Lower Trigonia Grit; above it are fossiliferous sands, then 12 ft. of Gryphæa Grit, and at the top the "Notgrove Freestone." In the seventh cutting, the section is continued upwards. The Notgrove Freestone is "bored" at the top, then follow Upper Trigonia Grit, 8 ft.; Clypeus Grit, 20 ft.; and then Fuller's Earth.

231. Ussher, W. A. E.—The Geology of Parts of North Lincolnshire and South Yorkshire.

Memoirs of the Geological Survey, ch. viii.—xiii.

Chapter VIII.—The Lower Oolites. The Inferior Oolite is divided into—

Lincolnshire Limestone	Hibaldstow Beds. Kirton Beds.
Basement Beds	Hydraulic Limestone. Lower Estuarine Sand and Clay. Dogger.

The Basement Beds are not above 26 ft. thick. The subdivisions are not traced separately, as they are not constant, and the Palæontological division should be some feet above the Hydraulic Limestone. The exposures are at "i" in Grayingham (of Dogger); south of Kirton Mill (Hydraulic); escarpment between Cleatham and Mount Pleasant, giving a section 29 ft., containing all the subdivisions; west of Stainwell Warren; the edge of the escarpment near Raventhorpe; beneath the railway at Santon; and in the stream at Ellerker, north of the Humber. No fossils are mentioned except the following from the Dogger at Grayingham:—

Galeropygus agariciformis.
Corbis rotundata.
Modiola Sowerbyana.
Pholadomya Heraulti.

The division of the Lincolnshire Limestone is local only, not being carried out north of the Humber or in the south of Lincoln. The Hibaldstow beds are buff coloured oolites, not more than 20 ft., and are the same as those called Ponton Beds. The Kirton beds are grey limestones, with loam and clay, and only occasionally oolitic. No thickness is mentioned, but the two together in Yorkshire are estimated at 67 ft. 6 in. The Kirton beds are shown at a quarry ⅝ mile N.N.E. of Grayingham Warren, by the road to Redbourne; ¼ mile from Kirton, showing cement stones and oolites, total 21 ft.; at the mouth of the tunnel, nearest Scaresby; around Kirton, where these cement stones are worked for hydraulic lime; between there and Scaresby, where a section of 30 ft. is given; by the Roman Road; ½ mile north of Kirton Tunnel; at "S" in Sturton Plantation, an 18 ft. section; east of Broughton, 8½ ft. seen; near Wressle Houses, 13 ft., and 20 ft. in two quarries; north of Barrow Hill, 14 ft.; lane at Low Santon Railway Bridge, 15 ft. The following fossils are recorded from these exposures:—

Terebratula globata.
——— maxillata.
Rhynchonella subangulata.
——— spinosa.
Ostrea gregaria.
Pecten lens.
——— annulatus.
——— aratus.
——— articulatus.
Gervillia acuta.
Lima duplicata.
—— punctata.
—— proboscidea.
—— bellula.
—— pectiniformis.
Pinna lanceolata.
Lucina bellona.
——— Burtonensis?
Trigonia hemispherica.
Corbis Lajoyei.
Pholadomya Heraulti.
Myacites jurassi.
Homomya gibbosa.
——— Vezelayi.
Gresslya abducta.
Astarte interlineata.
Quenstedtia oblita.
Nerinæa Voltzii.
Natica canaliculata.
Turbo gemmatus.
Serpula socialis.
Pseudodiadema depressa.
Thamnastræa Defranciana.
Isastræa Conybeari.
——— Richardsoni.
Latimeandra Flemingii.
Thecosmilia gregaria.

The Hibaldstow beds are seen badly characterised S.S.E. of Grayingham Warren, but are more oolitic near Hibaldstow Mill, in a 15—20 ft. quarry; at "n" in Island Pond, S.W. of Redbourne, 8 ft.; Waddingham Road, south of Redbourne; north of Kirton Tunnel, an outlier; by the Santon road on Risby Warren; near Mickle Holme; ½ mile north of Winterton. From all these places the only named fossils are *Lucina bellona*, *Trigonia hemispherica*, and *Rhynchonella spinosa*.

Chapter IX. Lower Oolites, Great Oolite series.—These are divided into—

Cornbrash.	Great Oolite Limestone.
Great Oolite Clay.	Upper Estuarine Series.

South of Hibaldstow, these are pretty clear, but when seen again at Brigg it is doubtful if there is any Great Oolite Limestone present, and at Appleby all is clay, representing the whole. The Upper Estuarine series consist of grey clay, with a little sand. It is seen near Waddingham, in a ditch. East of Redbourne Park it is mostly sand. Between Low Bank and Hibaldstow it is clay. The fossils noted are *Rhyn chonellaconcinna?* *Modiola imbricata*, and *Ostrea Sowerbyi*.

The Great Oolite Limestone is composed of broken shaly limestone. It is seen between Waddingham and Redbourne, between the latter and Redbourne Hays, and by the road to Hibaldstow. The rest are drain sections. The fossils recorded are :—

Rhynchonella concinna.	Mytilus furcatus.
Terebratula intermedia.	Trigonia undulata.
Ostrea Sowerbyi.	——— costata.
Avicula echinata.	——— striata.
Lima rigida.	——— flecta.
Modiola imbricata.	Myacites calceiformis.
Pteroperna plana.	

The Great Oolite Clay is shown by a boring to be about 24 ft. thick, but it is only exposed in ditches, where it yields *Ostrea gregaria*, *O. Sowerbyi*, and *Rhynchonella concinna*.

The Cornbrash is about 3 ft. thick, it weathers brown, and resembles the Great Oolite Limestone. It is seen three-quarters of a mile south-east from Waddingham Church, in a ditch by the road to Hibaldstow, near Appleby, and the rest are drain sections. The fossils collected are :—

Waldheimia ornithocephala.	Pholadomya Phillipsii.
———— obovata.	Astarte elegans.
Terebratula intermedia.	Isocardia rostrata.
Rhynchonella obsoleta.	Trigonia costata.
Ostrea Sowerbyi.	——— striata.
Avicula echinata.	——— flecta.
——— braamburiensis.	——— Moretoni.

Modiola imbricata	Trigonia elongata
——— gibbosa.	Holectypus depressus.
Myacites calceiformis.	Clypeus Plottii.
——— decussata.	Ammonites macrocephalus.
——— Vezelayi.	Strophodus magnus.
Ceromya concentrica.	

Chapter X. The junction between the Lower and Middle Oolites.—In a boring at Brigg, between a 2 ft. bed of Sandstone, representing the Kelloways rock, and a 3 ft. Limestone, representing the Cornbrash, was found 18 ft. of Blue Shale. Evidences of the occurrence of clay in this position are also found at the surface. In the absence of fossils, the question arises: Does this clay belong to the Middle or Lower Oolites? In Yorkshire, there are Lower Oolite clays above the Cornbrash, and in Lincolnshire the Kelloways rock does not lie at the base of the Oxford clay, but has clays below it, with Oxfordian fossils. As the present locality is continuous with the latter, it is concluded that the clay here is also Oxfordian.

Chapter XI. Middle Oolites.—Only Oxford Clay and Kelloways rock are recognised, the latter 20 ft. in thickness. It mostly consists of yellowish sands, with irregular consolidations of sandstone. It forms an escarpment, but is much covered. Near the southern margin of the map, rock is seen, also near Waddingham Holme; at Redbourne Hays Farm; at Gander Hill; near Gorbet Bridge; south of Kettleby Dyke; and at South Cave, in Yorkshire. The fossils recorded are :—

Gryphæa dilatata.	Belemnites Owenii.
——— bilobata.	

The Oxford clay is 300 ft. thick. It is seen at the base of a pit half a mile north of South Kelsey Church; its upper part in the cuttings between Wrawby and Barnetby, and between Barnetby and Brigg, and in the base of the cutting below the Elsham Road. Also at Winterton, Holme Hill. [But it is by no means clear how much of these clays are Oxfordian.] The fossils recorded are :—

Gryphæa dilatata.	Ammonites biplex.
Ostrea gregaria.	——— plicatilis.
Avicula inæquivalvis.	——— rotundus.
Modiola bipartita.	——— athletus.
Thracia depressa.	Serpula tetragona.
Nucula ornata.	——— tricarinata.
Leda Phillipsii.	

Chapter XII. The Relations of the Middle and Upper Oolites.

[This chapter is of very little use since the publication of Mr. T. Robert's paper, showing that part of the clays con-

tains a Corallian fauna—Q.J.G.S., vol. xlv., p. 545—but it is given for comparison.]

The only two places where a junction is thought to be seen are in the cutting north-east of Wrawby, and in a pit half a mile north of South Kelsey Church. In the former are found—

Serpula tetragona.	Nucula ornata.
Astarte carinata.	Thracia depressa.
Avicula inæquivalvis.	Cerithium costigerum.
Cardium striatulum.	Ammonites Bakeriæ.
Exogyra virgula.	——— rotundus.
Ostrea deltoidea.	——— athletus.
Gryphæa dilatata.	——— biplex ?

In the bottom part of the latter are—

Rhynchonella cf. oolitica.	Alaria trifida.
Gryphæa dilatata.	Ammonites plicatilis.
Pholadomya æqualis.	——— rotundus.

And in the upper part—

Gryphæa cf. dilatata.	Thracia depressa.
——— cf. deltoidea.	

The bearing of these facts is discussed, and it is decided to draw an important line through the middle of these clays [a feat which the surveyors elsewhere declare impossible].

Chapter XIII. Upper Oolites—Kimmeridge Clay.

There are very few exposures of this, and it is not distinguished lithologically from the Oxford clay. Those mentioned are—Elsham cutting, Wrawby cutting, Claxby Moor Brickyard, Holton Brickyard, Moortown Hill Clay Pit—1 mile south-west Nettleton Church—South Kelsey and North Kelsey, and Worlaby Brickyard. The fossils here recorded are—

Serpula tetragona.	Pholadomya æqualis.
Cidaris spinosa.	Thracia depressa.
Terebratula ovoides.	Alaria trifida.
Ostrea deltoidea.	Cerithium costigerum.
Exogyra virgula.	Ammonites alternans.
Pecten lens.	——— biplex.
Avicula inæquivalvis.	——— plicatilis ?
——— cf. expansa.	——— cymodoce ?
——— Münsteri.	——— Kœnigi.
Inoceramus expansus.	——— rotundus.
Modiola bipartita.	——— Kappfii.
Cardium striatulum.	Belemnites nitidus.
Arca longipunctata.	

Borings in Lias and Oolite rocks are given at Brigg, half a mile south-west of Scawby Station, road to Castlethorpe; Springwood Lodge (3); Roxby Grange (2); Haverholme Plantation; Appleby (north and south).

232. Cameron, A. C. G.—Note on the Recent Exposures of Kelloways Rock at Bedford.

Rep. Brit. Ass. for 1889, p. 577.

The rocks exposed in the numerous brickfields and stone pits, display 40 ft. of Jurassic strata, comprising Upper and Lower Oxford Clay, with Kelloways Rock between [rather an unusual position], and Cornbrash and Great Oolite Limestone, separated by a considerable thickness of purple clay. The sand of the Kelloways Rock has great doggers in it of a mushroom shape, with shales on the surface, but solid and calcareous within, sometimes 10 ft. across, as at Oakley Station.

233. Saunders, J.—Notes on the Geology of South Bedfordshire.

Geol. Mag., Dec. 3, vol. vii., p. 117.

This gives an account of the sections on the Midland Railway, the only Jurassic part being at Ampthill, whence he gives the following list of fossils from the "limestone bands":—*Cidaris florigemma*, *Exogyra nana*, *Pinna lanceolata*, *Ostrea gregaria*, *Trigonia irregularis ? Alaria trifida*. [These have quite a Corallian facies.] He also gives a list of 14 fossils from the Oxford clay.

CRETACEOUS.

234. Reid, C., and Strahan, A.—The Geology of the Isle of Wight. Second edition.

Memoirs of the Geographical Survey, pp. 349, with 5 Plates. (Dated 1889, but not actually published till 1890.)

The portion devoted to the Cretaceous rocks is written by A. Strahan. (Only the parts which appear to be new are here considered.)

The Wealden Rocks.—In Compton Bay there are two fossiliferous bands in the shales, though only one elsewhere—the lower fossiliferous shales are probably a local intercalation. A detailed section is given of the Wealden Beds from Compton Bay to Brook Point, showing 72 subdivisions in 960 feet of strata. Figures of *Cypris cornigera*, Jones; and *Candona Mantelli*, Jones, from the shales are given, and the various reptiles recorded from this series are noticed. Next we have a section of the Wealden Beds from Atherfield to near Brook [*i. e.*, on the south side of the anticlinal], showing 53 subdivisions in 747 feet of strata.

The Lower Greensand or Upper Neocomian.—The thickness at Redcliff is 600 ft., at Atherfield 800 ft., at Compton Bay 400 ft., and at Punfield 200 ft. The strata, therefore, thicken in a direction a little east of south. The junction between this and the Weald is everywhere absolutely sharp, so that a knife may be inserted at the exact spot. The base is a thin

line of coarse grits with rolled fossils from the oolites, and also from the underlying Wealden shales. The Wealden shales below present the appearance of having been disturbed and broken up for a foot or two. In Wiltshire, there is an actual unconformity. As the Lower Greensand is actually conformable to the Wealden in the Isle of Wight, we must suppose the latter to have been deposited in a land-locked area during the Middle and Lower Neocomian times.

The Lower Greensand is locally divided into—(1) Carstone; (2) Sandrock Series; (3) Ferruginous Sands; (4) Atherfield Clay. A detailed section in Compton Bay is given, showing Carstone 6 ft., Sandrock Series 81 ft. 6 in. in four subdivisions, Ferruginous Sands 251 ft. 6 in. in 25 subdivisions, and Atherfield Clay 60 ft. At Atherfield, the Atherfield Clay shows the "Perna Bed" in two parts, total 5 ft. 1 in. The Ferruginous Sands are correlated with 11 of Fitton's divisions (iv.—xiv.) including the "Crackers" at the base. A section of the Sandrock series near the Chalybeate Spring shows 184 ft. in eight subdivisions. At Sandown, a clay band 8 ft. thick cropping out 300 yards south of Shanklin Chine forms the top of the Ferruginous Sands. The Sandrock Series is seen at Luccomb and Knock Cliff 113 ft. thick in four subdivisions. At Redcliff, between Sandown and Culver Cliff, a section of the whole series is given, showing Carstone 72 ft. 9 in. in four subdivisions, Sand Rock series 93 ft. 6 in. in eight subdivisions, Ferruginous Sands 367 ft. 6 in. in 27 subdivisions, and Atherfield Clay in two subdivisions. A pebble band 4 in. thick near the top of the Ferruginous Sands is noted, it contains rolled specimens of *Ammonites biplex*, *A. cordatus*, *Cardium striatulum ? Cytherea rugosa ? Astarte contracta*, &c. A section at Punfield (20 miles west of the island) is given for comparison. It shows Carstone 4 in., Ferruginous Sands and Sand Rock series (not separable) 148 ft. 10 in. in eight subdivisions, including the "Marine Bed" of Judd; Atherfield Clay 49 ft. 3 in. in seven subdivisions, the two lower forming the "Perna Bed." The base is well marked, and shows large rolled phosphatic nodules. A list of fossils from the Atherfield Clay, and the limestone above it, which corresponds in position to the "Crackers," is compiled from Judd and Meyer, with the addition of *Corbula striatula ?* and *Ammonites Deshayesii*. From a soft sandstone in the Atherfield Clay are recorded *Arca Raulini* and *Panopæa plicata*, and for the "Perna Bed"—

Multizonopora rimosa.
Arca Cornueiliana.
—— Raulini.
Avicula depressa.
Cardita fenestrata.
Cardium subhillanum.
Cypricardia undulata.
Exogyra subplicata.
Lima lingua ?
Panopæa plicata.
Pecten interstriatus.
——quinquecostatus.

Some details are next given of the range of these beds inland in the island, which is chiefly ascertained by the feature of the Ferruginous Sands. The Sandrock series is correlated with the Folkestone Beds of the mainland.

A separate chapter is devoted to the Carstone. It has been seen to thicken towards the N.E. It resembles, and is probably the equivalent of, the Carstone of Lincolnshire. It passes up into the Gault, but is separated by a sharp line from the Sandrock series. It is doubtful whether it is recognisable in the Wealden area. There are pebble beds there with phosphatic nodules, which join on stratigraphically to the Gault. But at Folkestone, though the upper part of the Folkestone beds contains fossils of Gault affinities, no stratigraphical break is known to separate this part. The affinities of its fauna are divided. The following are named:—

Hoploparia longimana.	Pecten orbicularis.
Leda scapha?	——— quinquecostatus.
Lima parallela.	Plicatula Carteroniana.
	Ammonites Beudantii.

Detailed sections are given in Compton Bay (five beds), at the Chalybeate Spring (four beds), in the cliff below Niton (five beds), and at Monk's Bay (seven beds). At the latter locality a rolled specimen of *Enallaster Fittoni*, a Lower Greensand fossil, was found in a nodule bed.

The Gault is 120 ft. thick at Culver, 146 ft. at Blackgang, 139 ft. in Compton Bay, and at Punfield, where it has become more sandy, 111 ft.

It constantly slips over and conceals the Carstone. A. section is given in Compton Bay showing six beds, including the "Passage beds." It is supposed that the Isle of Wight Gault represents both Upper and Lower, but they cannot be separated.

The *Upper Greensand* consists of two members: 1. The Chert Beds; 2. The Malm rock. They thicken with the Gault. Thus, at Punfield, the Chert is 6 ft., Malm rock, 39 = total 45 ft.; at Compton Bay, 13 ft. + 73 ft. = 86 ft.; at Gore Cliff, 27 ft. + 94 ft. = 121 ft.; and at Culver the total is 80 ft. The Malm rock contains, in the south of the island, a "Freestone," and between this and the Chert a "Firestone." The beds below these, including the Gault passage beds, are Dr. Barrois' zone of *Am. inflatus*. The remainder is that of *Am. rostratus*. The Chert beds are full of sponge spicules. Sections are given at Compton Bay (three beds), Gore cliff (seven beds), Ventnor (twenty beds), Luccomb Valley (eight beds), Greatwood Copse (twelve beds), Culver Cliff (one bed), ¾ mile N. of Brook Church (two beds). The Chert beds form a marked feature on the surface of the country.

The *Chalk* is divided as follows:—

Upper Chalk	Chalk, with flints, about 1,350 ft.
	Chalk, nodular, but without flints, 15—25 ft.
	Chalk Rock, a line of green-coated nodules.
Middle Chalk	Thick-bedded Chalk with thin partings of Marl, 166 ft.
	Nodular Chalk (? Melbourne Rock) and
	Marl (? Belemnitella Marl), 14 ft.
Lower Chalk	Massive chalk, 86 ft.
	Thin-bedded Chalk and Marl in numerous beds, 120 ft.
Chloritic Marl.	

In Culver Cliff, a line of nodules, in the midst of the Upper Chalk, has been examined microscopically. The nodules contain numerous foraminifera and casts in glauconite. They are bored, and have young shells on the surface, showing they were formed at the time the chalk was making. The Chloritic Marl varies from 7 to 15 ft., and is apparently made up of two parts, one being the base of the chalk, the other the top of the Greensand—the phosphatized nodules containing derived fossils, including broken *Pecten asper*. It is seen in Compton Bay and Culver Cliff, but best along the Undercliff. At Punfield it is 3 ft. 6 in. thick, and has Chert beds below it with *Siphonia tulipa*, *Pecten asper*, *P. orbicularis*, *P. quinquecostatus* and *Am. varians*. Sections of chalk pits are given in the Military Road cutting, Afton Down, in a pit at the S.E. corner of Shalcombe Down, at the west end of Brixton Down, on Chillerton Down, in a quarry east of Carisbrook Castle, in a pit on the east side of Mount Joy, at the east end of Arreton Down, in a pit on Mersley Down, in a pit ½-mile W.N.W. of Yarbridge, in a pit west of Yarbridge, at Culver Cliff, where all three subdivisions are seen, *i.e.*, thick-bedded chalk 166 ft.; Melbourne Rock, 8 ft. 3 in.; Belemnitella Marl, 6 ft.; Massive Chalk, 86 ft.; and Chalk Marl, 120 ft.; also near Punfield, where the Middle Chalk is 111 ft., and the Lower Chalk 132 ft. thick.

Plate II. gives a horizontal section along the coast from Afton Down to Freshwater Down, showing the Cretaceous Rocks, and Plate III. gives Comparative vertical sections at Punfield, Compton Bay, Atherfield, and Culver.

Complete lists of Fossils are given in the Appendix.

235. Ussher, W. A. E.; Fox-Strangways, C.; Jukes-Browne, A. J.; Reid, C.—The Geology of Parts of North Lincolnshire and South Yorkshire.

Memoirs Geol. Survey, chapters xiv., xv.

In this district, the Cretaceous Rocks are divided into Upper or Chalk Series and Lower or Neocomian Series.

The Neocomian is divided into (1) Spilsby Sandstone; (2) Claxby Ironstone; (3) Tealby Clay; (4) Tealby Limestone; (5) Carstone; the total thickness being 80—90 ft. in

the south, which is lost in the north. All the subdivisions are passed through at the Acre House Mine described by J. W. Judd (Q.J.G.S., vol. xxvi.).

The Spilsby Sandstone is from 6—30 ft. thick above Nettleton and Elsham, and is sometimes indurated. At Acre House, it is sharp and economically valuable.

Claxby Ironstone is the oolitic worked bed. South of Nettleton it is 14 ft. thick, but dies away beyond Caistor. It is divisible into a more shaly, earthy portion, and a more oolitic portion. A good section is seen at the workings south of Acre House. The following fossils are recorded :—

Serpula gordialis.
——— antiquata.
——— filiformis.
——— plexus.
Waldheimia hippopus.
————— Juddii.
————— tamarindus ?
————— Walkeri ?
Exogyra conica
Exogyra sinuata.
Pecten cinctus.
——— orbicularis.
Trigonia nodosa.
Ammonites noricus.
————— nutfieldiensis.
Belemnites lateralis.
———— semicanaliculatus.

The Tealby Clay is yellow and 12 ft. thick at Hendon.

The Tealby Limestone is 14 ft. thick, and spreads out on the hills at Nettleton, and Caistor is built on it, and it dies out near Anderby. The Carstone is generally seen beneath the chalk, and it overlaps the underlying beds and rests in places on the Spilsby Sandstone; it thickens towards the east, and the Red Chalk appears stratigraphically to overlap it, though in sections they are conformable. It varies from 10 ft. to 20 ft. in thickness. The best sections are in Nettleton Dale. At Melton Rose, the Red Chalk lies on Spilsby Sandstone, and north of Elsham the Carstone disappears. It has the appearance of fine gravel, with quartz and Lydian stone pebbles, and phosphatic and ferruginous concretions.

There are two inliers of this below the chalk; one at Thoresway shows 20 ft., and another 9 ft., the Red Chalk being conformable; the other is in Rothwell Valley, where 9 ft. are seen, and there may be 5 ft. or 6 ft. more below the chalk.

The Upper Cretaceous rocks are divided into:—1. Red Chalk; 2. Lower, or Grey Chalk; 3. Middle Chalk, with flints; 4. Upper Chalk, without flints. The Red Chalk is 4—7 ft. thick. It consists of a nodular limestone in several beds, or of nodules in a marly matrix. It is seen at Woo Dale and Welton Springs in Yorkshire, Horkstow, Worlaby, along the edge of the wolds, above Barnetby, to Grasby, and in Nettleton Valley.

The Lower Chalk consists of the following :—

6.	Grey shaly marl..	2 feet.
5.	Hard greyish white chalk, with marly layers..	36 ,,
4.	Firm grey chalk, with green-coated nodules	3 ,,
3.	Rough thin-bedded grey chalk ..	26 ,,
2.	Hard gritty massive stone	4 ,,
1.	Hard yellowish-pink chalk	1½ ,,
		72½ feet.

No. 1 is the "sponge bed" of Hunstanton. No. 2 is the "Inoceramus bed." These, with No. 3 = the Chalk Marl. No. 4 corresponds to the Totternhoe stone. No. 5 is the band coloured pink near Louth. No. 6 is the *Belemnitella plena* bed. Sections are given at three-quarters of a mile east of Nettleton Church; Grasby, S. Ferriby, where both Lower and Middle Chalk are seen in a 72 ft. quarry. This, and the exposures across the Humber, have been described by Mr. Hill (Q.J.G.S., vol. xliv., p. 338).

The Middle Chalk is divisible into two very unequal parts, the lowest a yellowish chalk without flints, and the upper white compact chalk with numerous layers of flints. The lower is the zone of *Rhynchonella Cuvieri*; the upper, the zones of *Terebratulina gracilis* and *Holaster planus*. In the former is the equivalent of the Melbourne Rock; in the latter the flints get more abundant towards the top; and the fossils noted are *Inoceramus Cuvieri* and *I. Brongniarti*. Sections are given S.E. of Caistor, in Elsham Church Wood, and at Hessle, where 61 ft. are shown, but the zone of *Holaster planus* is not believed to be reached. Inliers are mentioned in Thoresway and Cabourn Valleys, and a large number of pits given. The Middle Chalk forms a cliff on the east of the wolds, against which the Drift abuts.

The Upper Chalk is nowhere exposed, being everywhere covered by Drift.

[**236.**] **Lamplugh, G. W.**—On the Speeton Clays and their Equivalents in Lincolnshire.

Paper read to the British Association on Sept. 5, but not published in 1890.

237. Lamplugh, G. W.—The Neocomian Clay at Knapton.

"The Naturalist," p. 336.

Professor Judd considered that the clay at Knapton—now unworkable—represented the lower part of the Speeton Section, and consequently that the Red and White Chalk are unconformable on the Neocomian. By an examination of the fossils from Knapton in S. Kensington, Cambridge, York, and Scarborough Museums, the writer concludes that they are Upper Neocomian. He finds *Am. Deshayesii* labelled

Am. Knaptonensis, Bean MS.; also *Terebratulina Martiniana* of the zone of *B. jaculum*, and *Pholadomya Martini?* The coprolite bed found at Knapton need not be *the* coprolite bed at the base, for there are three at Speeton, and this may be the highest at the base of the Red Chalk [a passage quoted below from Young and Bird seems rather to negative this], in which case, the occurrence of Red Chalk overlying the various Jurassic deposits may be merely due to overlap on the Pre-cretaceous anticline.

238. Saunders, J.—Notes on the Geology of South Bedfordshire.

Geol. Mag., Dec. 3, vol. vii., p. 117.

This gives an account of the railway sections and other exposures between Flixhill and Luton. No fossils (beyond some teeth, &c., from Millbrook) are recorded from the Lower Greensand or Gault. The Chalk Marl, with the Totternhoe Stone and Lower Chalk, is seen in the Chalton cutting, with *Turrilites Mantelli* and *Palæga Carteri*, and a large Belemnite, referred to *B. lanceolatus* of Sowerby. It is noted that the Totternhoe Stone is used at St. Alban's Abbey and Luton Church, and also sent to Scotland. The Middle Chalk, with Melbourne Rock, has already been described by A. J. J. Browne, (Q.J.G.S., 1885). The Middle and Upper Chalk is best seen in the Midland Railway cuttings between Luton and Chiltern Green, and the Chalk Rock which separates them is rich in fossils. A series of lists of fossils is given—first a general one showing 33 species from the Upper Chalk, 30 from the Chalk Rock, of which 23 are distinct, and 17 from the Middle Chalk; another, already published, list of 41 species from the Chalk Rock, collected by Dr. Morison, and a longer list of species, comprising 29 from the Lower Chalk, 15 from the Totternhoe Stone, and 33 from the Chalk Marl.

239. Blake, J. H.—Geology of the Country near Yarmouth and Lowestoft.

Memoirs of the Geological Survey.

From an old boring at Yarmouth, at Lacon & Co.'s Brewery, he concludes that the thickness of the chalk there is at least 1,300 ft., and its base being 1,806 ft. below sea level, there must be an average rise of $\frac{1}{8}^{\circ}$ between Yarmouth and the outcrop at Hunstanton.

[**240.**] **Dalton, W. H.**—On the Undulations of the Chalk in Essex.

Paper read to the Essex Field Club, but not published in 1890.

EOCENE.

241. Reid, Clement, and Strahan, A.—The Geology of the Isle of Wight. Second edition.

Memoirs of the Geological Survey. Chapters viii. to xii. By Clement Reid.

The Reading beds are 84 feet thick at Alum Bay, 110 ft. at Downend, 92 ft. at Ashey, 140 ft. at Brading, and 163 ft. at Whitecliffe Bay. The variation in thickness may be due to varying pressure of the chalk from the south. A section is given of the railway cutting at Brading, where the series consists of variously coloured clay, with two bands of sand. Only plant fragments have been found.

The basement bed of the London clay can be traced, as a pebbly band, both in Alum Bay and Whitecliffe Bay. *Cyprina Morrisii* and *Cytherea orbicularis* are noted for the first time here. A measured section of the London clay in Alum Bay is given, showing 9 subdivisions in 233 ft.

The Bagshot beds are all mapped together, being practically only seen in the cliff sections. A section of the Lower Bagshots is given in Alum Bay, showing 662 ft. in 20 subdivisions, the leaf bed being 200 ft. from the base. Though now worked out, it was never more than a local pocket where leaves had drifted; they are almost all dicotyledonous, and the flora, as a whole, is "the most tropical of any that has, so far, been studied in the Northern Hemisphere." The Reading and Woolwich flora are temperate, but the London clay is nearly as tropical, but represents a different local assortment. There is also a great and almost inexplicable break between this flora and that of Bournemouth. It is the special character of the Alum Bay flora which has misled Palæobotanists to consider those not like it to be Miocene. The following provisional list of plants is given by **J. Starkie Gardner.**

Apeiobopsis Symondsii, *De la Harpe.*
Aralia primigenia, *De la Harpe.*
Cæsalpina æmula, *Heer.*
——— Bowerbankii, *De la H.*
——— brevis, *De la H.*
——— mollis, *De la H.*
——— Salteri, *De la H.*
——— phaseolites, *Unger.*
——— Ungeri, *Heer.*
Ceropetalum myricinum, *De la H.*
Chrysodium lanzæanum, *Visiani.*
Cluytia aglaiæfolia, *Wess and Webb.*
Comptonia acutiloba, *Brons.*
Dalbergia Salteri, *De la H.*
Daphnogene anglica, *Heer.*
——— veronensis, *Massal.*
Dryandra Banburyi, *De la H.*
Elæodendron Heerii, *De la H.*
Ficus Bowerbankii, *De la H.*
—— Forbesii, *De la H.*
—— granadella, *Massal.*
—— Morrisii, *De la H.*
Grevillea La Harpii, *Heer, MS.*
Juglans Sharpei, *De la H.*
Laurus Forbesii, *Unger.*
——— jovis, *Unger.*
——— primigenia, *Unger.*
——— Salteri, *De la H.*
Marattia Hookeri, *E. H. and Gard*
Podocarpus elegans, *De la H.*
——— eocenica, *Unger.*
Quercus eocenica, *De la H.*
——— lonchitis, *Unger.*
Rhamnus densinervis, *Heer.*
Zizyphus integrifolius, *Heer.*
——— vetustus, *Heer.*

The Bracklesham beds contain a layer of coal with underclay, seen in both Bays. Sections already published are given, and a new detailed section of the coaly portion in Whitecliffe Bay; also a section and list of fossils from Ashey cutting, where the Bracklesham closely approaches the London clay, and the fauna is mixed.

A new section of the Barton clay in Whitecliffe Bay is given, showing six subdivisions in 162 ft., the top and bottom beds being very fossiliferous. The overlying sands are called the "Headon Hill sands," as it is thought that they belong to a higher zone than the Upper Bagshots.

With regard to the Oligocene beds, it is stated that the new survey does not uphold the criticisms of Prof. Judd, but confirms the former survey. Details are given of the beds containing *Clupea vectensis* at King's Quay, near Osborne. A section is also given of the beds associated with the Insect Limestone west of Gurnard Ledge. This formed a band (now quite destroyed) 3 in. thick, lying in Bembridge Marls, 3 ft. 10 in. above the Bembridge Limestone.

The *Hamstead Beds* are divided into Marine beds 31 ft., and Freshwater and estuarine beds 225 ft. A detailed section of the whole has been measured at Hamstead.

	ft.	in.
Upper Hamstead Beds—		
Pale bluish-green clay with *Ostrea callifera*	11	0
Carbonaceous and ferruginous clays with broken *Cyrena semistriata*, *Cuma Charlesworthii*, and *Voluta Rathieri* ..	1	0
Stiff blue clay with *Corbula pisum*, *Cerithium plicatum*, *C. elegans*, *Voluta Rathieri*, and *Strebloceras cornuoides* ..	7	0
Black clay full of *Corbula vectensis;* also *Cytherea Lyellii*, *Cyrena semistriata*, *Hydrobia Chasteli*, *Cerithium plicatum*, *C. elegans*, *Melania fasciata*, and *M. inflata*	0	6
Shaly clays, with *Cyrena semistriata*, *Cerithium plicatum*, *Hydrobia Chasteli*, *Mya minor*, and *Paludina lenta* ..	4	6
Shell bed full of *Cerithium plicatum*, *C. elegans*, *Hydrobia Chasteli*, *Melania inflata*, and *Cyrena semistriata*	0	9
Sandy clays with bands of *Paludina lenta*	4	0
Stiff blue clay with *Cyrena semistriata;* carbonaceous at base with *Mya minor*, *Cerithium plicatum*, *C. elegans*, *Hydrobia Chasteli*, *Melania inflata* and *Corbula vectensis*	1	6
Laminated carbonaceous clay	1	0
Lower Hamstead Beds—		
Green clay 3½ ft., carbonaceous clay ½	4	0
Mottled clays 11 ft., obscure ditto 18 ft.	29	0
Carbonaceous seams with *Carpolithes ovum* and *Paludina lenta*	2	0
Carbonaceous clays, with seams of *Melania inflata*, *Hydrobia Chasteli*, and seeds	15	0
Bluish loam 1 ft., clay with seeds 3 ft., obscure 4 ft. ..	8	0
Clays with occasional seams of *Carpolithes ovulum* and obscure 5 ft...	25	0
Laminated carbonaceous clays with seeds, Palm leaves, Water Lily leaves, *Paludina lenta*, and *Candona* ..	1	9

	ft.	in.
Green and red marls 8 ft., obscure 60 ft.	68	0
WHITE BAND, Green clays and white shell marls with *Melania fasciata, Cerithium inornatum, C. Sedgwickii, Mya minor*	6	0
Green clay with ironstone nodules 7 ft., obscure 28 ft. ..	35	0
Black or slate-coloured carbonaceous clay full of *Cyrena semistriata* and *Nematura pupa*. Also *Bithynia conica* and *Cyclas Bristovii*	3	0
Green clay 1½, black laminated clays with *Planorbis obtusus* and *Cyclas Bristovii* 6 in., green clays 4 ft. ..	6	0
Mixed black and green clay full of *Melania muricata, Hydrobia Chasteli*, &c.	0	3
Green Clay with *Nematura* and *Melanopsis carinata*	20	0
BLACK BAND full of *Paludina lenta, Unio* at base	1	6
	255	9

The only traceable beds are the *Corbula* and *Cerithium plicatum* beds, the water lily and leaf beds, the White Band, the *Nematura* bed, and the Black Band. It is by recognising the last in the cores brought up by boring in about 300 places that the wide distribution of the Hamstead beds on the surface has been recognised, details of which are given. The Marine beds are confined to Hamstead and Bouldnor. The only named plants known in the Hamstead beds are—

Andromeda reticulata, *Ett.*
Arthrotaxis Couttsiæ, *Heer.*
Carpolithes Websteri, *Brong.*
——— globulus, *Heer.*
Cyperites Forbesi, *Heer.*

Complete lists of fossils are given in the appendix.

Some remarkable dislocations of Tertiary beds are seen in Colwell Bay.

242. Gardner, J. S.—Report of the Committee appointed for the purpose of Exploring the Higher Eocene Beds of the Isle of Wight.

Rep. Brit. Ass. for 1889, p. 89.

These have not been so prolific as was hoped. The flora of the Osborne beds in no way differs from that of the rest of the Oligocenes. A new fruit, about the size of a damson stone, has been found in the Hamstead beds. Cones and leaves of the so-called *Sequoia Couttsiæ* have been there found in good preservation, proving that it is really an *Arthrotaxis*, a river-side bushy conifer. The cones from Bovey may be *Sequoia*, but their structure is not observable. They have flat seeds with narrow marginal wings, while those from Hamstead are small, uncompressed, and wingless. This reduces the similarity of the Bovey to the Hamstead flora, the former of which has *Anona* fruits, the latter those of *Carpolithes globulus* and *Cyperites Forbesi*, in both cases exclusively. The only fruit common to both is *Carpolithes Websteri*, which also occurs in the Lower Headon of Hordwell. Other plants, as *Osmunda lignitica* and *Goniopteris stiriaca* and some palm spines, are [as yet]

absent from Hamstead. The distinction in age of the two floras is therefore considered proved.

243. Klaassen, H. M.—The Pebbly and Sandy Beds overlying the Woolwich and Reading Series on and near the Addington Hills, Surrey.

Proc. Geol. Ass., vol. xi., p. 464.

Excavations have been made along a line from Shirley Road, Croydon, to Addington Hills, which give a continuous section from the Blackheath pebble beds to the Woolwich and Reading series. It is said that this throws light on the question as to what formation the intermediate sands and clays belong to. A section is given, of which the stratigraphy is obscure, as Woolwich beds are represented as cut off along an oblique line, and as passing into the overlying sands which, in turn, *pass into* the pebble beds. [It may be taken that the section gives no stratigraphical information.] At the highest point, 10 ft. of Pebble beds are seen; at the next, grey sand with few pebbles; then layers of impure pipe-clay and of yellow loam, 21 ft., grey, brown, and silver sand, with thick layers of pipe-clay without pebbles, 10 ft. These are called the Oldhaven beds, and the following analysis is given of the pipe clay by **A. Tarn**:—

Silica	77.86
Alumina	12·67
Ferrous oxide	2·25
Lime	1·09
Magnesia	·90
Potash	1·40
Loss	3·55
	99·72

This is all the information given, and the light it throws on the question above mentioned is not explained. The rest of the paper discusses the old Park Hill section.

244. Elwes, J. W.—Additional Notes on Fossils at Fareham and Southampton.

Proc. Hampshire Field Club, p. 80.

A continuation of former papers. Gives a list of 80 species or varieties from the London Clay, at Fareham—indicating the particular locality of each. Four additional species are also recorded from the Bracklesham beds at Southampton.

[**245.**] **Sherborn, C. D., and Burrows, H. W.**—Report on the Microscopical Examination of some Samples of London Clay, from the Excavations for the Widening of Cannon Street Railway Bridge, London, 1887.

Paper read to the Geologists' Association on Dec. 5, but not published in 1890.

246. Martin, E. A.—A Visit to the Bovey Tracy Coal Formation.

The Field Club, pp. 152, 153.

A chatty description of the visit. He calls the clays "Miocene" still.

247. Monkton, H. W.—The Bagshot Beds of Essex.

"Nature," vol. xlii., p. 198.

Remarks on a section at Brentwood, given by Prof. Prestwich, which completes the series of the Bagshots in the district, viz.: *a*. Yellow and white sand; *b*. Green sands and clays with fossils; *c*. Yellow sands with seams of clay, total, 50 ft. These have Plateau gravels above, and London clay below. The fossils he has found in beds corresponding to *a* show that these are more nearly allied to the Marine Middle Bagshot than to the Lower, and the overlying pebbles may be the remains of Upper Bagshot.

248. Irving, A.—Further Notes on the Stratigraphy of the Bagshot Beds of the London Basin (North Side).

Abstract in Proc. Geol. Soc., Session 1890-1, p. 2.

[This abstract fails entirely to give the facts on which the author's arguments may be founded, but says "he proceeded to bring forward new evidence," "he brings forward new evidence," "he now has actual data." The author's view appears to be that on the north side of the London basin, the Lower and Middle Bagshots gradually die out, and the Upper overlaps them, so that the question raised is as to the Upper or Lower Bagshot character of certain beds. In the absence of fossils, and from the variability of the beds, and the similarity of those on possibly different horizons, this is a difficult matter to prove, and can only be done, if at all, by tracing definite beds from spot to neighbouring spot. This the author seems to claim to have done, but his opponents say his "diagrams" are "very incorrect," and "his arguments rest on assumptions." It seems, *a priori*, probable that such beds as the Bagshots should die out locally.]

PLIOCENE.

249. Reid, C.—The Pliocene Deposits of Britain.

Memoirs of the Geological Survey of the United Kingdom. With a map of the distribution, and four plates of fossils. Pp. 326.

This is the first of a series of general memoirs "designed to present a compendium of all that is known regarding each of the geological formations, in its distribution through the United Kingdom." It includes not only a description of the

British representatives, but a correlation of these with similar continental deposits.

Chapter I. The subdivisions adopted are as follows :—

Base of the Pleistocene. Artic Freshwater Bed (with *Salix polaris and Betula nana*).

Newer Pliocene (cold temperate).	*Leda myalis* bed (classed provisionally with Pliocene. Forest bed Series { Upper Freshwater, Estuarine, Lower Freshwater } Gravels with *E. meridionalis* at Dewlish. Weybourn Crag (and Chillesford Clay?) Chillesford Crag. Norwich Crag and Scrobicularia Crag. Red Crag of Butley. Walton Crag (Lower Red Crag).
Older Pliocene (warm temperate).	S. Erth Beds. Coralline Crag Lenham Beds. Box Stones and Phosphate Beds (with *remanié* early Pliocene fossils).

[He mentions, just before this, that the Pleistocene were formerly called Newer Pliocene, so there is some danger of confusion in adopting the same term for other beds.]

The Older Pliocene occupies, at the very most, 15 or 20 square miles of surface, while the Newer occupies about 1,200.

Chapter II. The Nodule beds, or basement beds of the Crag.

[This and most of the other chapters commence with a history of the study of the group in question. The description is, to a large extent, taken from these writings, which cannot be here recapitulated; only those parts can be noted that appear to be new, either in matter or arrangement.]

The only place where the Nodules have been worked below the Coralline Crag is Sutton; but it is stated that "Coralline Crag phosphate" has been worked in Boyton Marshes. The Red Crag phosphate, *i.e.*, where it occurs at the base of the Red Crag in the absence of the Coralline [can they then be of the same age? or do the phosphates in the latter case *represent* the Coralline?] has been worked within the triangle formed by lines from Ipswich to Orford, and to the Stour, at Dovercourt. The "box stones" found in these beds, so called from their hollow cavities, are also phosphatized, but not to paying quantities. The Mollusca as yet found in them are :—

Cassidaria bicatenata.	Cardium decorticatum.
Conus Dujardini.	Cyprina islandica.
Dentalium Dentalis.	——— rustica.
Ficula reticulata.	Glycimeris augusta.
Nassa conglobata.	Isocardia cor. and var lunulata.
Trochus ziziphinus.	Panopæa Faujasii.
Voluta *auris-leporis.*	Pecten opercularis.
——— Lamberti.	Pectunculus glycimeris.

Those in italics occur nowhere else in Britain; there are no characteristically Miocene Shells nor Miocene Mammals.

The working of the phosphate nodules decreased from 12,000 tons in 1854 to 2,000 tons in 1887; since which time it has been on the increase, viz., 3,000 in 1888 and 5,000 in 1889.

Chapter III. Coralline Crag.—The exposures on Aldborough shore have been built over. The various exposures are noted in order, and a section is given of Broom Pit, Gedgrave, together with a list of fossils from here and from Gorner Pit—both published by Prestwich in 1871. Sutton, Ramsholt, and Tattingstone exposures are outliers. Everywhere the rocks are current bedded, even at Broom Hill Pit, which is said to show horizontal bedding. At Sutton, current bedding is less marked, but the rolled *Salicornaria* prove the presence of currents, and the Polyzoa require them. Thus there is no evidence that this crag was deposited in too deep water for currents, but probably from 40 to 60 fathoms. The percentage of recent Mollusca was made by Wood to be 60 per cent., by Jeffreys 84 per cent.; the difference being due to their "personal equation," but foreign palæontologists go further in Wood's direction. Of the Polyzoa, about 36 per cent. are recent. The greater part of the other organisms are extinct. The conditions of deposit are best matched among the Azores or off the coast of Portugal.

Chapter IV. Lenham beds.—These consist of fine glauconitic greensands, which are often changed into rusty sands or compacted into ironstone. Those lying on the chalk in Kent have sometimes been erroneously taken for Eocene. They occur at Lenham in pipes in the chalk, filled with clay and sand, and descending to the base of the quarry, where they are left standing as pillars when the chalk is worked away. The coating of the pipes is black clay, and the chalk flints in them are mixed with the glauconitic sand. The depth of these pipes may be as much as 80 ft., and the quarry is near the summit of the Downs. At Harrietsham, as described by Prestwich, the hollow is funnel shaped, and there is stratification by subsidence parallel to the surface of the funnel. Other patches, which may not be the same, occur under similar circumstances as far as Folkestone; but the Glauconite in these cases has all been changed. They are not fossiliferous across the straits in France until Diest, in Belgium, is reached. He gives a list of Diestian fossils, 189 in number; of these the following have been recognised at Lenham:—

Acteon tornatilis.	Astarte Basteroti.
Buccinopsis Dalii.	——— Galeotti.
Bulla lignaria.	——— Omalii.

Calyptræa chinensis ?
Cancellaria contorta.
Cerithium tricinctum.
Chenopus pes-pelecani.
Cypræa europæa.
Dentalium costatum ?
Emarginula fissura.
Eulima subulata.
Ficula reticulata.
Fissurella græca.
Fusus lamellosus.
Margarita trochoidea.
Nassa prismatica.
Natica millepunctata.
——— varians.
*Pleurotoma consobrina.
————— Jouanneti.
————— turrifera.
Purpura tetragona ?
Ringicula ventricosa.
Scalaria clathratula
*Terebra acuminata.
Triton heptagonum.
*Trochus cinerarius.
———— millegranus.
———— ziziphinus.
Turritella incrassata.
*Arca diluvii.
—— lactea.
Artemis lentiformis.
Cardita senilis.
*Cardium papillosum.
*———— n. sp.
Cyprina islandica.
Cytherea chione.
Diplodonta astartea.
————— rotundata.
*Gastrana fragilis.
Hinnites crispus
Isocardia cor ?
Kellia semistriata.
Lepton deltoideum.
Lima Loscombi ?
Lutraria elliptica.
Mactra arcuata.
*Nucula sulcata.
Ostrea princeps.
Pecten maximus.
——— princeps.
——— varius.
*——— n. sp. ?
*——— n. sp. ?
Pectunculus glycimeris.
Pholadidea papyracea.
Solen ensis.
*Tellina Benedeni.
——— donacina.
Thracia pubesceus.
———— ventricosa.
Terebratula grandis.

* Not found in Coralline Crag.

Considering the whole fauna, wherever obtained, all but 22 species have been found in the Coralline Crag, of which 14 point to the Diestian being newer, and 8 to its being older, but out of the Lenham shells alone 11 are not found in the Coralline Crag, 4 of which are recent and 1 is a Red Crag species. The general facies of the Lenham fossils is southern.

Chapter V. The St. Erth Beds.—These are in the valley between Mount's Bay and St. Ives Bay, in a hollow or channel between a boss of slate and a hard projecting elvan dyke. One section shows :—

Angular Head	3 feet.
Head and Clay mixed..	2 „
Mottled Clay	6 „
Blue Shelly Clay (base not seen) ..	1½ „

The list given by Kendall and Bell (Q.J.G.S., vol. xliii., p. 201) is reproduced, and 40 per cent. are said to be extinct, and the whole to be of a southern type. For these reasons, he considers the bed to be of the age of the Coralline Crag. He argues that it must have been deposited in 40-fathom water, in spite of containing shells of the laminarian, or 15-fathom, zone, because, in the latter case, the shore line would have been only 400 yards away [as there is only one pit, how can we tell that this is not the case ?], and because of the

clay, which would want calmer water than could be had at 15 fathoms. This he considers confirmed by the occurrence of sands and clays at St. Agnes Beacon, "exactly at the level needed" [but did *these* clays require 40 fathoms of water? and if not where are the littoral shells?]. The whole of the Upper Tertiaries of Cotentin he correlates with the Older Pliocene.

Chapter VI. Red Crag.—The successive stages of the upper crag overlap each other as they are followed northward. At the southern extremity of the area at Walton is the oldest Red Crag, with a fauna closely allied to that of the Coralline Crag. A few miles to the north the Red Crag of Sutton and Butley, with many arctic mollusca, rests directly on the Coralline Crag; above this comes a lighter band, the *Scrobicularia* Crag. Proceeding northward, we pass an area where the strata may be called either Red Crag or Norwich Crag, but in the Waveney Valley undoubted Norwich Crag rests directly on Eocene or Chalk. Still further north, the Weybourne Crag comes to rest on the chalk.

The following analysis shows the character of the Walton Crag Molluscan Fauna :—

Percentage in	*Coralline Crag.*	*Walton Crag.*
British and not Mediterranean ..	5·1	8·8
British and Mediterranean	39·4	41·2
Mediterranean and not British ..	13·0	9·5
Neither British nor Mediterranean ..	6·1	6·8
Not known living	36·3	33·8

Thus extinct species are fewer, southern species are rarer, and those belonging exclusively to British or northern seas are more plentiful, and this comes out still more strongly when the actual number of specimens is considered. But though *Trophon antiquum* is common, neither *Tellina obliqua*, *T. lata*, *T. prætensis*, nor *Nucula Cobboldiæ* are here found. The exposures of Red Crag recorded by various observers are then noted, but the coprolite pits at Felixstowe are now all closed. The best pit for collecting in 1889 was on the east side of Foxhall Hall; another pit ½ mile south of Newbourn Church has recently been opened. The Sutton pits are now much obscured. The south-western part of the cliff at Bawdsey exhibits some of the clearest sections. In the Scaldisian beds of Antwerp most of the Red Crag species are found, with the exception of those of arctic character. We may parallel it, therefore, with the Walton Crag.

Chapter VII. Red Crag continued.—Norwich Crag and Chillesford Crag. The upper beds of the Red Crag are found on the north of Butley River, as at Chillesford, where the sands contain mollusca with united valves. The best section is seen in the Aldborough Thorpe Pit. In Thorpe Cliff none can now be seen, but Dunwich is an important locality,

where the arctic and estuarine character is very marked. A list of 43 mollusca is quoted from Crowfoot and Dowson's paper (Proc. Norw. G.S., vol. i., p. 80). Other exposures are then referred to, and a list of 98 species from Yarn Hill and Easton Bavent is quoted from Prestwich (Q.J.G.S., vol. xxvii., p. 345) and Wood's Monograph. From the former locality, bones of sea birds and of *Arvicola intermedius* have been recently obtained. At Aldeby there is a marked increase of individuals belonging to arctic forms, but no additional species. There are many united bivalves in the position of life, and derivative fossils are absent. A list of 66 species is quoted from Crowfoot and Dowson. Here 4 ft. of the pebbly series overlies 10 ft. of Chillesford Clay, resting on 7 ft. of Chillesford Crag. In 1888, a well at Broome Place, 2 miles N.N.E. of Bungay, showed:—

Valley gravel	40 feet.
Boulder clay	32 „
Pebbly series	29 „
Norwich crag	48 „

The following fossils occurred in a bed of the latter:—

Chemnitzia internodula.	Mya arenaria.
Natica catena.	Mytilus edulis.
Purpura lapillus.	Nucula Cobboldiæ.
Turritella terebra.	Pecten orbicularis.
Cardium edule.	Scrobicularia plana.
Corbula gibba.	Tellina obliqua.
Cyprina islandica.	Balanus crenatus.
Mactra ovalis.	

There is probably an old chalk cliff near Hoxne. The crag of the Waveney Valley has been described by H. B. Woodward, and it covers a large extent of ground in the Bure Valley; but much confusion has been introduced into the nomenclature, the beds being very variable, and with different common fossils. Though called Mammaliferous Crag, the bones of mammals are very rare, but are most numerous towards the base. Numerous other exposures are finally noted, extending to the north of Norwich—mostly by quotations from the Memoirs by H. B. Woodward.

Chapter VIII. Chillesford Clay and Weybourn Crag.—The latter appears to be merely a sandy modification of the former, in a more exposed area. The southernmost representative of these is at Walton Naze, but he thinks this may really represent the Cromer Forest bed. The section in 1886 was:—

	Soil	1½ feet.
Chillesford Clay or Forest bed.	Gravel, without boulders	5 „
	Bedded loam, with angular flints ..	1—3 „
	Gravelly sand	⅓ „
	Stiffer clay	1½ „
	Black carbonaceous loam	1 „
	Gravel of flints and quartzites ..	½ „
	Red Sand	6 „

The first undoubted exposure is at Chillesford itself. The "clay" consists of fireclay, with a small quantity of quartz sand, plates of mica to $\frac{1}{20}$-in. diameter, and limonite. No large grains or micro-organisms were observed. At Iken brickyard, the clay lies on Coralline Crag. He then follows the coast north of Southwold. At Kessingland, undoubted Cromer Forest beds occur, but they do not alternate with the Chillesford Clay, but lie in its hollows. North of Lowestoft it disappears, to reappear at Happisburgh, and the interval is scarcely bridged by inland sections. At Happisburgh Church a boring showed:—

Forest bed ..	Sandy clay	2½ feet.
	Sandy clay and gravel	4 „
Chillesford Clay or Weybourn Crag	Clay and sandy clay, very micaceous	17½ „
	Micaceous blue sand	½ „

These latter are continuous into the shelly crag northwest, called Weybourn Crag, so they must be on the same horizon. The same beds were reached in a boring at Mundesley.

At Trimingham, on the north shore, is seen:—

Forest Bed ..	Carbonaceous clays with lignite, &c.	
Weybourn Crag	Laminated micaceous clay ..	4 ft.
	Green loamy sand with shells and teeth of *Arvicola* ..	3 „
	Laminated greenish clay ..	4 „

The centre layer is full of undoubted Weybourn Crag Shells, *i.e.*:—

Buccinum undatum.
Littorina littorea.
Natica catena.
Pleurotoma turricola.
Purpura lapillus.
Trophon antiquus.
Turritella terebra.
Astarte borealis.
——— compressa.
——— sulcata.
Cardium edule.
Corbula contracta.
————gibba.

Cyprina islandica.
Leda oblongoides.
Lucina borealis.
Mactra ovalis.
Mya arenaria.
—— truncata.
Mytilus edulis.
Nucula Cobboldiæ.
Pholas crispata.
Saxicava arctica.
Tellina balthica.
——— lata.
——— obliqua.

This section is only three miles from the undoubted Chillesford Clay, and the relations ought to be made out between, but they cannot be seen. The writer thinks the two beds synchronous. From Cromer to Weybourn the Crag has been described. Towards West Runton it gets more sandy, and has yielded most fossils. Beyond this the base shows *Pholas* borings in Chalk. He gives a section at Weybourn showing Boulder Clay on the top, and a small patch of the "Upper Freshwater Bed" on the west. Then the "Forest Bed? estuarine" is continuous, and

beneath this is the Weybourn Crag, which has in it a seam of clay. This band of clay is taken by Prestwich to be the Chillesford Clay, and the overlying beds to be "Westleton Beds." This correlation he objects to, because the clay is discontinuous and the fossils above and below are the same. Further west, at Leatheringsett, he calls 4 ft. of shingle and loamy sand the Weybourn Crag.

Finally, he gives a "Table of the Marine Mollusca of the Pliocene Beds."

	Total.	Arctic.	Mediterranean.	Extinct.
Weybourn Crag ..	53	9	0	5
Chillesford Crag ..	90	7	2	14
Fluviomarine Crag ..	112	9	7	18
Red Crag of Boyton, &c...	199	13	23	55
Red Crag of Walton ..	148	2	22	50
Coralline Crag ..	420	1 ?	75	169

[The remainder must be recent British.] This shows well the gradual incoming of Arctic conditions, and of recent forms of life.

Chapter IX. Cromer Forest Bed.—When complete, this consists of three divisions: an Upper and Lower Freshwater bed, and an intermediate Estuarine deposit. The Rootlet bed is on the upper surface of the latter. He believes the great tree stumps are not *in situ*, but have been washed off the river side and formed snags, because (1) they are imbedded in stratified clay and not earth; (2) the roots never end in fibres, but are broken off short; (3) earth is found in cavities between the roots; (4) many are lopsided as if growing on a steep bank, and some have grown together in this way. There is no evidence of difference in age between parts of the series. An angular block of felsite was found in these pre-glacial gravels at Sherringham, but it is not scratched. The best exposure is at Beeston Hill, published in the Cromer Memoir. In the Upper Freshwater beds, some marine fossils are found washed out of the Estuarine beds. The best locality for bones is at Runton. Here also the largest boulder has been found, viz., one of $2 \times 1\frac{3}{4} \times 1$ ft. of granite. The Lower Freshwater bed can only be seen *in situ* near Cromer and at Trimingham. The beds previously referred to the Upper Freshwater bed at Mundesley, are now considered to belong to the Arctic Freshwater bed (above and not below the *Leda myalis* bed). The most southerly point in which the Forest bed is fossiliferous is at Kessingland. In comparing this series with the Norwich Crag, the marine fossils show it to be more allied to this than to Pleistocene beds, and the land Mammals show it to be intermediate.

Distribution of Land Mammals—

	Total Species.	Living.	Extinct.
Nodule Bed	28	3	25
Norwich Crag	13	1 ?	12
Forest Bed	45	24	21
Pleistocene	49	41	8

The land and freshwater mollusca are 35, of which 5 are extinct, and 5 no longer British, which is about the same proportion as in the Weybourn Crag. The flora shows that the climate was mild and moist, but little colder than at present, and, leaving out the large extinct mammals, the forms of life are very similar to those of the "Broads" to-day, but point to a land connection with the Continent. An analysis of the stones contained in the gravels, particularly the absence of liver-coloured quartzites derivable from the Midland counties, and the abundance of other stones than flint, shows that the river must have come from the south-east, and was probably a continuation of the Rhine.

In Chapter X., notice is taken of the flinty sand at Dewlish, described by O. Fisher (Q.J.G.S., vol. xliv., p. 818). This is considered to be the Pliocene, and possibly of the age of the Cromer Forest bed, on account of the occurrence of *Elephas meridionalis*. [This has been also recorded from Bielbecks, in Yorkshire.]

Chapter XI. Foreign Equivalents of the English Pliocene Strata.—The observations are mostly general, but the Pliocene of the South of France is thus correlated: Arnusian =Forest bed, Norwich Crag, and Upper Red Crag; Astian = Lower Red Crag?; Plaisancian=Coralline Crag, and the Messinian is wanting in England. When the Coralline Crag fauna is compared with that of the Mediterranean, it is to the existing Mediterranean species, and not to the Pliocene ones, that we find the most resemblance, but nowhere could a deposit of such a character be matched. Several freshwater deposits of Pliocene age scattered over France show that this period was an essentially continental one. The Mammalian Fauna of the Val. D'Arno Pliocene is remarkable for its resemblance to that of the Forest bed, showing that the Alps at that time did not present a barrier to migration, but there is little or no community in the freshwater shells.

The appendices to this work are: I. Tables of Fossils. II. Bibliography. The first shows 1,428 animals, and the last, 492 books. The four plates represent the most characteristic of: I. Extinct Marine Mollusca. II. Southern Marine Mollusca. III. Arctic Marine Mollusca. IV. Land and Freshwater Mollusca of the Crag.

250. Blake, J. H.—The Geology of the Country near Yarmouth and Lowestoft (Sheet 67).

Memoirs of the Geological Survey.

The Reading beds under Yarmouth are 46 ft. thick. The thickness of the London Clay in the same boring is 310 ft., but as this was made in the middle of an estuary mostly filled with alluvial deposits 150 ft. deep, the total may be reckoned at 400—430 ft. The Southwold boring, however, shows it must be still thicker.

In the Pliocene beds, the first series is the Chillesford Clay. This is seen at the Cliff at Pakefield for a distance of 1,100 yds., when the shore is cleared. It contains no fossils, and is sandy. The Rootlet bed is seen above. At Corton, the Chillesford Clay occurs on the shore, and inland at Mutford. The gravel and sand, with Mammalian remains, is placed above the Chillesford Clay in the Memoir, the opinion of the author that it is below being overruled by the authorities. These gravels are seldom to be seen on the coast near Pakefield, only when some gale clears away the shingle. "It is on these occasions, when the connection of the beds cropping out along the foreshore with those that occur in the cliff is so clearly exhibited, that their relative age can be proved by direction superposition." [If this means that they can be *seen* underlying the Chillesford Clay, no "objections" to their being there can get over the *fact*.] The Rootlet bed, of the Forest bed series, is seen at the same places on the coast as the Chillesford Clay. It varies from 4½—10 ft. in thickness, and is full of rootlets and peat; laminated beds, and fossiliferous gravel are associated in places. The age of this Rootlet bed appears to depend on the identification of two "laminated clays," one at Kessingland Cliff, the other at Covehithe Cliff, 2½ miles to the south. The former is undoubtedly followed immediately by the Rootlet bed clay, the latter is as undoubtedly Chillesford Clay. These two are said to be identical in character, and to have been traced and mapped inland across the interval. [In this case, the Mammaliferous gravel cannot lie between.] The Peat is considered by C. Reid to belong to the beds below; by the author, to the series above.

In Appendix III. are given lists of the Mammalia from the Forest Bed series at Kessingland and Pakefield, and contained in the museums of Jas. Backhouse, York; Norwich; Practical Geology, London; and Dr. Crowfoot, of Beccles. They are:—*Ursus spelæus*, *Canis lupus*, *Hyæna crocuta*, *var spelæa*, *Machærodus*, *Trichechus Huxleyi*, *Equus caballus*, *E. stenonis ? Rhinoceros etruscus*, *Hippopotamus amphibius*, *Sus scrofa*, *Bison*, *Cervus elaphus*, *C. polignacus*, *C. Savinii*, *C. Sedgwickii*, *C. verticornis*, *Trogontherium Cuvieri*, *Castor fiber*, *Arvicola intermedius*, *Elephas antiquus*, *E. meridionalis*, *E. primigenius ?*

A list of plants from the Rootlet bed, all common British ones, is also given.

251. Dalton, W. H.—On the Upper Clay of Walton Naze.

"Essex Naturalist," vol iii., p. 223 (for 1889, issued in 1890).

This has generally been called Chillesford Clay. Clement Reid thinks it may possibly be of Forest bed age. The writer thinks it post-glacial, like similar clay at Clacton. Fossils have not been found in it.

252. Farrar, A.—A Remnant of Pre-Glacial England.

Proc. Leeds Geol. Assoc., p. 41.

A description of the Forest bed of Cromer, following the published statements.

253. Bell, A.—Third Report of the Committee appointed for the purpose of Reporting on the Manure Gravels of Wexford.

Report Brit. Ass. for 1889, p. 92.

The investigation is incomplete, and proofs of conclusions not yet forthcoming. These conclusions are: 1. That the "Lower, Middle, and Upper Drifts" of Ballybrack Bay are not true "Drift" deposits, but belong rather to the St. Erth [Pliocene] sea bed, which extended to the Isle of Man, and perhaps to Aberdeenshire. 2. The Severn drifts are of much later date, not originating till Ireland was separated. 3. The faunas obtained both in England and in Ireland, near Dublin and Wicklow, are *remanié*, and not in their original habitat.

[**254.**] **Bell, A.**—Fourth and Final Report . . . . upon the "Manure" Gravels of Wexford.

Read to the British Association in September, but not published in 1890.

GLACIAL AND SUPERFICIAL.

255. Strahan, A.—The Geology of the Neighbourhoods of Flint, Mold, and Ruthin.

Memoirs Geol. Survey, chapters x.—xii.

In this district there are pre-glacial pipes, which have been described by Maw (Geol. Mag., vol. iv). They are filled with white and yellow sand, and clay in bands parallel to the sides. They are noticed at Rhes-y-cae, Long Rake, China Rake, Bwlch Farm, Moel-y-crio, Colomendy Hall, Maes-y-safn Mine, and Pant du Llanfarres. They have been worked (70 years ago) for pottery, under the name of "Rock Cambria." The pipe at Rhes-y-cae contains vegetable mould, the relic of a former land surface, and fragments of Millstone Grit, which at the time of its formation

must have lain above it. The rock, however, is now 450 yards away to the east, and the surface of the limestone is 200 ft. from the top, according to the dip; all this denudation must therefore have taken place since their formation. They are overlaid by Boulder Clay, and are therefore pre-glacial [and the weathering of the limestone, and of part of the Millstone Grit must have taken place in the *previous* interval].

The glacial deposits are partly Boulder Clay and partly sand and gravel, but their relative age is indeterminable. The district includes part of the boundary between the northern and the local drift. The latter has travelled from the W.S.W. across the strike of four great belts of rock—Trias, Wenlock Shale, Carboniferous Limestone, and Millstone Grit—and the *débris*, after passing each, is largely composed of their respective fragments. The striæ on the rocks run in the same direction. In the *Vale of Clwyd*, the clay and gravel are very mixed; the latter being on the whole the lower and containing much Wenlock shale. On the east, the gravel travels up the hills. In the *Valley of the Wheeler*, red sand has been carried up from the Vale of Clwyd, and yellow clay with Wenlock fragments rises to 1,000 ft. On the side are eskers, running parallel to the valley. The *Upper Valley of the Alyn* is a continuation of this, and has similar characters, the clay reaching 1,100 ft. There is an esker at Maes-y-groes. The *Lower Valley of the Alyn* shows coal dust in the drift, and there is a good esker at Baily Hill, Mold. South of Nerquis, the Boulder Clay is deep and has little gravel. In the valley of the Terig there is an old pre-glacial valley filled with glacial deposits. Further down the Blackbrook has been turned aside and has made a short cut to the Alyn, wearing its course down to the Coal Measures. The old dry valley is indicated at North Leeswood Colliery by a channel 27 yards deep, which cuts out the Cannel coal, and is full of gravel. Further down, it is proved in the same way down to 20 yards, and further again down to 30 yards below the surface. Below Hartsheath there are two outstanding eskers, and the pebbles are, in large proportion (25—60 per cent.), composed of limestone. The plateau of *Halkin Mountain* is nearly 1,000 ft. high, yet most of it is covered with drift. There is also an esker at Moel-y-crio, where fragments of sea shells have been observed in sand up to 965 ft. From Caerwys northwards, the Boulder Clay contains abundant Wenlock fragments, and must, therefore, have come from the west; but the sand is not in the same spot and may be older or newer. It forms hillocks trending W.N.W. At Ffynnon-graenaw, about 90 per cent. of the boulders are foreign to the neighbourhood, and at Brynford the sand with shells contains drifted coal,

probably from the east, showing the mingling of the two drifts.

In *the Coal-field and Triassic area,* **C. E. De Rance** states that sands and gravels mostly underlie the Boulder Clay, and in the following places contain one or more of the shells *Psammobia ferroensis, Tellina balthica, Turritella terebra,* and *Buccinum undatum,* viz., at Kiln, above Victoria Mills, Wepre Hall, and Knowl Hill, Buckley. The deposits rise in several places to 300 ft. and at Knowl Hill to 561 ft. Above the Victoria Mills, a thickness of 80 ft. of sand and gravel is seen below Boulder Clay. At Tyn-y-pistill, there are two Boulder Clays with Sands between; as also near Nant Mill and near Vinegar Hill. Near Hope Junction, a bed of sand dies away in the midst of the clay. Many of the Boulders are of Lake District ash, and on the coast near Burton are flints like those of Ulster. The glacial striæ have all been previously recorded. With regard to the Boulders, the observations of Mr. Macintosh (Q.J.G.S., vol. xxx.) are confirmed and quoted. [Several large boulders are mentioned and their size and position are given, but their nature and probable origin being omitted, they are of comparatively little interest.] There are two considerable deposits of river gravel in this district; one is near Rossett, where the Alyn has spread out a kind of delta over six square miles; the other in the Vale of Clwyd, where the Clywedog debouches into it. The calcareous tufa which spreads out in flats in the valleys of tributaries to the Wheeler at Caerwys and Ysceifog, which have been described by Mr. Maw (Geol. Mag., vol. iii., 1866), are also noticed. They contain numerous land shells.

256. Ussher, W. A. E., and Reid, C.—The Geology of Parts of North Lincolnshire and South Yorkshire.

Memoirs Geol. Survey. Chapters xvi. and xvii.

The description is divided into districts. The first is west of the Wolds and south of the Humber. This comprises the valleys of the Ancholme and Trent. In ascending order of time the deposits here are Chalky Boulder Clay, Old Gravels, Low Level deposits of the Ancholme Valley and Brown Boulder Clay, Sand, Peat, and Alluvium of the Trent Valley, Peat and Alluvial Deposits of the Ancholme Valley, Blown Sand.

The Chalky Boulder Clay is bluish grey, with numerous chalk and flint fragments, and occasionally grits and quartz. It covers the higher part of the Oxford and Kimmeridge Clays in the Ancholme Valley, and of the Lias in the Trent Valley; but it does not reach within five miles of the Humber. In the former valley, it contains large boulders, up to 5 ft., of siliceous grit, as near Cadney; but, with this exception,

nothing but chalk and flint is mentioned. In the Trent Valley, we read of "Saccharoid grit and quartz"; near Northorpe, "Jaspideous fragments;" near Scotter, "Lias Limestone and Shale, White saccharoid, and other grits, and a purplish, porphyritic rock"; also "Rhætic and Keuper Materials" about Scotterwood. At Laughton, are two large boulders, one 5 by 4 by 3 ft., a "greenish grey rock"; the other a "grey fossiliferous rock resembling quartzite."

The Old Gravels occur partly on the summit of the Oolitic escarpment, where they are composed of oolitic fragments, and are thought to be possibly pre-glacial [though how the ice could get from the chalk to the Lias without clearing them off is not very obvious]; the rest are on the slopes of the valleys which have been excavated since the formation of the Chalky Boulder Clay; and they are intermediate in age between this and the Brown Boulder Clay of lower levels. Sections are given of these gravels at Wrawby and Yaddlethorpe, which show them to be exceedingly irregular and torrential. At Flixborough the gravel is 80—100 ft. above the alluvium, and to the north rises to 200 ft. above sea level. It occurs at the same height at High Burnham, the highest spot in the Isle of Axholme, and consists here of coarse Red Sand, with Marl and Triassic Sandstone, and, occasionally, igneous rocks.

The low level deposits consist principally of Brown Boulder Clay which occurs down to 2—3 ft. below the alluvium, and 20—30 ft. up on the slopes above it. It is believed that this is of later glacial age, but it is pointed out that in that case the whole of the valley must have been excavated between the times of the two deposits of the glacial period, and very little since. In the detailed description, flints and oolitic stones are the only materials mentioned in the associated gravels on the west of the Ancholme; but on the east side north of Elsham, all is chalky. On the Humber Cliff, near South Ferriby, a mass of the brown clay is seen, resting on an old sea beach of chalk pebbles.

The newer deposits in the Trent Valley show that they formerly contained marine or estuarine sands; on these Peat grew up to 8 ft. in thickness, and on Brumby Common there is found a bed of Peat of 20 ft., resting on (probably) Rhætic shales, and overlaid by sand. In the Ancholme Valley, two Peats are recognised: the lower one has its surface 8—16 ft. below the ground. In the Island Carr Brickyard, Brigg, an old plank road was found, under 1 ft. of Peat and 5 ft. of Clay, the level being 13 ft. below high water in the Humber. All this district is remarkably covered by masses of blown sand.

The district north of the Humber on this map is of little

note. There are gravels near Cave and Everthorpe almost composed of *Gryphæa*, and in the latter place a deposit of chalk gravel has been banked up against a Middle Lias cliff. On the Banks of the Humber are seen chipped trees below high water mark, and covered with warp.

With regard to the district east of the Wolds, there appears to be little new to add to the description already given in the same author's "Geology of Holderness," in which the whole district is taken together. There are two Boulder clays of the same character and a middle band of Interglacial Marine gravel. This latter is of two types—the fossiliferous and the unfossiliferous gravel, the former generally marine, and showing a cold but not Arctic climate.

The Post-glacial deposits are Peat, Clay, and Brickearth. The most remarkable is the peat found at the top of Kelsey Hill, which rises 40 ft. out of the Marsh, showing a former depression to this amount.

257. Reid, Clement.—The Pliocene deposits of Britain. Memoirs of Geological Survey. (*See* No. **249**.)

Chapter X. of this volume deals with beds which lie above the Pliocene rocks of the Eastern counties, the lowest of which may even belong to that epoch. These lowest beds are divisible into two, the "Leda myalis Bed," and the "Arctic Freshwater Bed." The former is not seen at Weybourn, but first occurs at Old Hithe, and at Lower Sherringham contains the following in sand:—

Littorina littorea.	Mytilus edulis.
Purpura lapillus.	*Ostrea edulis.
Cardium edule.	Tellina balthica.
*Cyprina islandica.	†——— obliqua.
	*Balamis sp.

Those marked * have both valves [no *Leda myalis ?*]. The bed is continuous from Beeston to Cromer, and at Runton Gap it is 15 ft. thick and contains the above and

Buccinum undatum.	*Astarte borealis.
Littorina rudis.	*Leda myalis.
†Trophon antiquus.	*Mya truncata.
Natica catena.	

† May be derived.

He concludes that this bed is most conveniently included with the Pliocene. The Arctic Freshwater bed is only known in four localities, and is specially characterised by the occurrence of the leaves of *Salix polaris* and *Betula nana.* The four places are Lower Sherringham; Beeston, where the loam occupies a channel in the Forest bed, in this case it is doubtful whether this bed lies really above the *Leda myalis* bed or below—the two nowhere occur with characteristic fossils in the same locality; Mundesley, where there are 1½ ft. of stiff

blue clay with sand and loam below; and Bacton, where 2 ft. are seen immediately below the Boulder Clay. The contents of this bed indicate a temperature lower by 20° than the Upper Freshwater bed, and for this reason the author classes it rather with the glacial beds. [But *Betula nana* is a British plant now, and no fossils are mentioned except *Spermophilus* and *Salix polaris* that are not British at the present day. *Spermophilus* lives in Austria, and several Arctic willows are found living in Britain, one as far south as Glengariff.] The beds above described are the Mundesley beds of Professor Prestwich, which include also the "Upper Freshwater." The shingle beds in other places may be of various ages, and hence they are only called "Pebble Gravels," the name "Westleton and Mundesley beds" not being accepted, as nothing new is considered to have been brought forward to support it.

258. Blake, J. H.—The Geology of the Country near Yarmouth and Lowestoft.

Memoirs of the Geological Survey, chapters iv. to ix.

The "Pebbly Series" is seen at Pakefield and Corton, and is said to be represented at Kessingland by laminated clays [but this correlation is considered doubtful]. It is nowhere fossiliferous on the coast. Details are given of similar pebbly sands at Burgh, Gorleston, Somerleyton, Herringfleet, Burgh St. Peter, Wheatacre, Ellough, Mutford, and Kessingland inland.

The Glacial deposits are divided into three. The Lower Glacial consists of loam with boulders, of a maximum thickness of 21 ft. It has a clear base line, but an eroded surface, and is sometimes quite absent. It has a maximum thickness of 12 ft. at Corton, where basalt boulders are rather common, but there is none at Kessingland or Pakefield. The clays at Waxham, West Somerton, Martham, Hemesby, Ormesby, Thrigby, Runham, Burgh Castle, Gorleston, Blundeston, Somerleyton, Oulton, North Cove, Mantby, West and East Caistor (many of which are worked for brick, and of which sections are given), are referred to this. In several cases it contains fragments of marine shells.

The Middle Glacial beds consist of sand, and are only so called to indicate their age. They vary from 30—50 ft. down to zero, and are locally full of shells in a fragmentary and waterworn condition. These sometimes occur near the top, but occasionally near the bottom. The sand is siliceous and buff in colour, sometimes finely bedded, sometimes false bedded, and occasionally ripple marked. They are well seen in the three cliffs. At Gunton they have yielded a clay once worked for "Lowestoft china." Inland, these sands are described as at West and East Somerton, Martham, Hemesby,

Ormesby, St. Michaels and St. Margarets, Rollesby, Filby (fossils), Thrigby, Runham, Stokesby, West and East Caistor, Burgh Castle (fossils), Bradwell, Gorleston, Lound (fossils), Herringfleet, Somerleyton, Blundeston, Corton, Gunton, several places round Lowestoft, Oulton, Aldeby (several places), Wheatacre, Burgh St. Peter (several), Carlton Colville, Mutford, Worlingham, Ellough, Rushmere, Gisleham and Kessingland.

The Upper Glacial consists of the main mass of Boulder Clay, which is continuous all over Norfolk and Suffolk. It is very uniform in character, the greater portion consisting of subangular and rounded fragments of chalk and flint clustered in unstratified clay. Hence it is well called the "Chalky Boulder Clay." Its greatest thickness here is 35 ft., but it has been greatly denuded. Oolitic fossils are found in it, and occasional—but very few—layers of buff sand. No fragments of shells have yet been found. Its lower boundary is a very even one. He considers that it must have been brought by ice rafts. The three cliffs show it well. The largest boulders are about 3 ft. in longest diameter, and some mentioned are composed of Carboniferous Limestone, Lias Limestone, Flint, Chalk, and a quartzose unknown rock. Inland, good exposures of it are described at Winterton, East and West Somerton, Martham, Hemesby, Ormesby, St. Margarets (from which a list of 2 Cretaceous, 19 Oolitic, and 5 Lias fossils is given), Ormesby, St. Michael, Filby, Thrigby, Runham, Mantby, East Caistor, Burgh Castle (where a long section is exposed (figured) showing a very irregular base), Tritton, Somerleyton, Hopton, Corton, Lowestoft, Oulton, Burgh St. Peter (3), Wheatacre, Carlton Colville, Aldeby, in many of which places it is worked for bricks.

The plateau gravel caps the hills, the valleys having been excavated since its deposit, especially that at Gunton, the upper end of which was originally to the east, now in the North Sea. It stands at two places 97 ft. and 74 ft. above sea level. It consists of unstratified, coarse flint gravel, and contains no fossils. Details are given at Burgh Castle, Tritton, Ashby, Hopton, Corton, and Gunton, where there is 23 ft. of it, 11 being loam at the base, and Lowestoft, where there are 17 ft., with loam and brown silt, Oulton, Aldeby, and Burgh St. Peter.

The alluvial deposits are sometimes 120 ft. thick, extending far below sea level, and resting on Eocene beds at Yarmouth, as shown in section.

259. Prestwich, J.—On the Relation of the Westleton Beds, or Pebbly Sands of Suffolk, to those of Norfolk, and on their extension Inland, with some Observations on the period of the Final Elevation and Denudation of the Weald and of the Thames Valley, &c.

Pt. i., Q.J.G.S., vol. xlvi., p. 8.

This is preceded by a historical review of the opinions held concerning all the different beds which occur in the East of England above the Chillesford Clay and below the Boulder Clay. These beds are "the Westleton beds," the "Bure Valley Crag," "The Weybourn Sands," and "The Forest bed." The two latter he places with the Crag, and consequently the only choice of names lies between the two former. He prefers the term "Westleton and Mundesley beds," suggested by him in 1881, to "the Bure Valley beds," because the beds in that valley have not a well-defined position either stratigraphically or palæontologically—or to the term Pebble beds, as there are so many other pebble beds. The Westleton beds are characterised by 50—60 per cent. flint pebbles, 10—20 per cent. quartz pebbles, 10—34 per cent. subangular flints, and the remainder of various kinds, so that the whole indicates a southern source, whereby they are distinguished from the glacial beds. He gives vertical sections at Westleton, at Covehithe Cliff where, below the Westleton beds, with a festooned base, come a possible commencement of the Forest bed, then the Chillesford Clays, and then the fluviomarine crag, all in 24 ft.; at Trimlingham, at Kessingland Cliff, and Pakefield, with the Forest bed series below; thus the Westleton beds overlie the Forest bed series. At Trimlingham, Pakefield, and Bacton, the Boulder Clay is seen above. At Mundesley, below the Boulder Clay, are seen nine beds. The two uppermost are classed by C. Reid as "Arctic Freshwater beds," and included in the Glacial series; below it lies the "*Leda myalis* bed," and "Upper Freshwater bed," of the Forest bed series. All these the author classes together as Mundesley beds. At West Runton Gap, the Westleton shingly character again returns with characteristic pebbles, and with Boulder Clay above and Forest bed below. The Forest bed group contains the "Forest bed" and the "Lower Freshwater bed of Reid. He then gives a list of fossils of the Westleton and Mundesley beds, from localities only where they lie above the Chillesford Clay or Forest bed. It includes 28 plants, 81 invertebrates, and 38 vertebrates, of which five are extinct.

Part ii., Q.J.G.S., vol. xlvi., p. 120, pl. vii.

This paper traces the range inland of the sands and gravels referred to the age of the Westleton beds. These when not shingle are of white or ochreous sand. 1. *Suffolk.*—They are seen on Leeston Common lying on Crag; at Brandeston they underlie the Boulder Clay. At Ufford Bridge they lie between the two. At Kyson they cap the Crags, and have the usual kinds of pebble. At Finnford Bridge they are 12 ft. thick, near Tuddenham 4 ft. At

Bramford, a bed referred by Whitaker to Crag, may be of Westleton age. Near Burstall they have the usual composition. 2. *Essex.*—At Walton-on-the-Naze 5 ft. cap the Crag. Those at Clacton are doubtful. The sands below the Boulder Clay near Sudbury may be these, as may be those at Stoke. They occur in the cutting between Bures and Chapple, and between Chapple and Mark's Tey—where the Boulder Clay is unconformable—similarly north of Witham. Between Black Notley and Braintree they are first faulted and then cut into by the Boulder Clay, as also at Braintree, where they are possibly 70 ft. thick. At Thaxted both are faulted; at Malden they are 120 ft. above O.D., west of Witham they are still below the Boulder Clay. Nowhere as yet are they 200 ft. up. But they now rapidly rise and leave the clay in the vales below; but there is here [unfortunately] a considerable break. The next seen are on Highbeech, at 340—370 ft.; at Gaynes Park at 540—560 ft. 3. *Middlesex.*—At Barnet they are 410—460 ft. up; at Highwood 400—410 ft. up, the Boulder Clay being 100 ft. lower. At Horsington they are only 278 ft. up. Possibly they are on Hampstead at a height of 412 ft., at South Mimms 400 ft., and at Potter's Bar 380—400 ft. 4. *Hertfordshire.*—At Hatfield the Westleton beds are 320—380 ft. up, the Boulder Clay 180—240 ft. lower, on an eroded surface. At Shenley Hill, at 406 ft.; at Collier's End, 348 ft.; at Sacombe Green, 362 ft.; at Ayot, 406 ft.; and Burnham Green, 407 ft.; at Hemel Hempstead, 456 ft.; at Langley Common, 440 ft. 5. *South Bucks.*—At Tiler's or Crowcroft Hill, about 600 ft.; at Penn, 600 ft.; at Lane End, High Wycombe, 600 ft. 6. *South Oxfordshire.*—At Nettlebed Hill, 650 ft., their highest point; at Greenmoor Hill, 560—600 ft.; and at Goring the same. 7. *Berkshire* and *Wiltshire.*—At Bowsey Hill, Henley, at 350 ft.; at Upper Barildon, 400—420 ft.; at Newbury, 560 ft. perhaps; at Baydon, near Swindon, and finally near Calne. In all these outliers the beds are recognised by the character of their pebbles. There are possibly some Westleton beds at Draper's Point, Sheppey; also possibly at Kingsdown, near Bathford, at 550 ft.; at Clevedon, and near Warminster. Thus the beds which lie below the Boulder Clay on the east, rise above its level on the west.

The flint pebbles may come from Woolwich beds, the quartzite from the Ardennes, the subangular flints from the southern drift; the chert and ragstone from the L.G.S. of Kent, &c.; the large flat quartzite from the Woolwich beds, the Lydian stone, &c., from the Ardennes. From their fossils in Suffolk, the beds are marine, and are decalcified when not covered by Boulder Clay on the west. Similar

gravels are found in the Ardennes. It follows, from the positions on the sides of valleys, that the Thames and Lea were not excavated when the Westleton sea was there, the difference of level giving the amount of subsequent denudation. At Goring, the early glacial denudation is 160 ft., the glacial 220 ft., and the post-glacial 20 ft. The chalk escarpment could scarcely have existed when these were deposited, and in any case 300—350 ft. of strata have subsequently been denuded which reduces it by so much. We have evidence also of the greater elevation of the west at a later date.

[It seems that the inferences of this paper depend on the identification of the Westleton beds by their pebbles, which other observers find very difficult; and there is a want of continuity in the sections where they are said to emerge from below the Boulder Clay, and a curious irregularity in their heights. Nevertheless, the hill gravels are undoubtedly Pre-glacial, and some of the valley gravels Post-glacial. Hence, the erosion of the Thames was probably commenced between the Crag and the Glacial periods.]

Part iii., Q.J.G.S., vol. xlvi., p. 155, pl. viii.

This deals with another set of gravels, which the author calls the Southern Drift [a misleading term, as it is *not* a boulder clay of southern origin]. The contents are subangular flints, Lower Tertiary flint pebbles, subangular chert and ragstone, a few pebbles of white quartz, and ironstone grit. This differs from the Westleton shingle by the lack of large quartz pebbles and by the abundance of ragstone. The localities of this gravel are :—1. *Kent:* At Cobham Park, Rochester, at 400 ft., at Swanscombe Hill at 316 ft., at Well Hill, near Chelsfield, at 550—600 ft., where it is very coarse, and between Eynsford and Farningham, from 250—350 ft. 2. *Surrey:* At West Hoe Hill, Norwood, at 360—380 ft., possibly on Wimbledon Common, here mixed with Glacial Drift (*i.e.*, gravel). At St. George's Hill, Weybridge, at 245 ft., with a few white quartz pebbles. On Merrow Down, Guildford, and over the Bagshot, Chobham, and Frimley ridges, at 350—415 ft. 3. *Berks:* On Cherry Down (Burleigh) near Ascot, 300 ft. up and 220 feet above the Thames. On Gravel Hill at 400 ft. 4. *Hants:* On Hungary Hill at 577 ft., and on Cæsar's Camp at 600 ft. Here the ragstone is rarer, and Sarsen stones commoner. At Heckfield at 300 ft. 5. *Wiltshire:* On Upper Kirby Green Hill, near Inkpen, at 573 feet. In the western portion, the ragstone pebbles become almost lost. The L.G.S. to the south has not been here uncovered.

There are two other Pre-glacial gravels:—1. At Hampstead Rayleigh, Langdon Hill. These are more like the

Southern Drift than the Westleton, but may be mixed. 2. The Brentwood Group: At 300—350 ft., the Boulder Clay being 150 ft. lower, from Writtlepark to Norton Heath, and from Brentwood to Warley and Billericay. These, also, are mixed, but partly with Bagshot pebble beds. At Stanmore, at 400—500 ft., is a similar gravel, without ragstone. The same occurs north of Pinner, 380 ft.; at Brockley, 416 ft.; Elstree, 450 ft.; and on Shooter's Hill at 424 ft.

We now come to the inferences. The Woolwich bed pebbles are derived from the denudation of the chalk on the Weald axis. In the earliest Pliocene times, the area was submerged, and the Crag of Lenham of Diestian age (*i.e.*, earlier than British Crags) was deposited on the worn surface of the sloping chalk, the longitudinal Wealden Valleys, which are of later date, being subsequent to their later upheaval. Before these were carved out, the Wealden hills were more than their present height, by the addition of the sum of the overlying strata, including only 100 ft. of chalk, the rest having been denuded, the total being 260 ft. This has ever since been in process of denudation, and has yielded the gravels of the Southern Drift. The oldest is that of Well Hill, where the stones are large, the ragstone very scarce, and the deposit almost torrential, being then at the bottom of a valley. It is probably of Red Crag age. As the denudation proceeded, the ragstone pebbles became more abundant. Later still, the drainage became more restricted to its present course, and the Medway and other gravels were formed. At Smitham Bottom, Croydon, is an early valley only half-formed, with ragstone pebbles in its gravel. Its higher part is cut off by the Mole Valley. It is lower, and, therefore, later than the Well Hill gravel. The Southern Drift is rather local, and may have been originally so. It is, probably, generally synchronous with the Chillesford Clay, Forest bed, and Westleton shingle. It was possibly this Wealden range which stopped the northern ice sheet. There is similar gravel on the south side of the Weald. At the base of the White Crag there are subangular flints, but no ragstone; hence the Weald was not then denuded down to the Lower Greensand; but in the bottom of the Red Crag there *are* ragstone pebbles, so the Greensand had then been reached. After this, the area north of the Weald was submerged. At this time, the transverse Wealden valleys must have opened on the sea. Then there was a S.W. and N.E. upheaval through central England, in the direction of the chalk escarpment. Thus a drainage to S.E. was formed, which, combining with the north drainage from the Weald, produced the easterly drainage of the Thames, which then first commenced to flow and to erode. At that time, the higher Thames, above Goring, passed by

the Isis into a large river flowing into the Wash, and was only connected with the Lower Thames by a later, possibly Glacial, erosion. The results of the paper are summed up in eleven propositions, the nature of which may be gathered from the above. The plate gives the positions of all the localities of all the drifts referred to.

260. Holmes, T. V.—On the Nature of some of the Gravel Patches in Essex.

" Essex Naturalist," vol. iv., p. 100.

An abstract of Prof. Prestwich's paper " On the Relation of the Westleton Beds, &c.," as far as relates to Essex.

261. Lamplugh, G. W.—On a new Locality for the Arctic Fauna of the " Basement " Boulder Clay in Yorkshire.

Geol. Mag., Dec. 3, vol. vii., p. 61; also Rep. Brit. Ass. for 1889, p. 590.

This locality is at " South Sea Landing," Flamborough. Brown boulder clay occupies the summit of the cliff, and chalk, here more excavated than usual in Pre-glacial times, is at the base. Between these is chalk rubble overlaid by gravel and sand, in the midst of which latter is a lower mass of Boulder Clay, which dies out at a point in the section. In the midst of this last is a crumpled seam, 24 ft. by 4 in. and less, of greenish yellow sand, and the surrounding clay shows signs of washing. In the minor streaks, the shells are in fragments, but in the main seam a small proportion are in perfect condition, and sometimes the bivalves contain sand in their umbonal region, even when buried in clay. He considers that the whole bed has been moved bodily, and sheared in the process, the shells having been extracted from a sand bed. He records 19 species, all found also at Bridlington, of which the following are the commonest:—*Pecten islandicus*, *Cyprina islandica*, *Astarte borealis*, *A. compressa*, and *Dentalium striolatum*. As no shells occur in any of the surrounding strata, he concludes these must have been transported from a distance, possibly first out into the North Sea, and then back by a Scandinavian ice sheet.

262. Lamplugh, G. W.—Glacial Sections near Bridlington. Part iv.

Proc. Yorks. Geol. and Polyt. Soc. New Ser., vol. xi., p. 275. Pl. 13.

A new opening of the Basement beds has taken place where a sea wall has broken, and is now rebuilt. They contain patches of shelly beds as usual, with large *Pectunculus glycimeris* and *Cyprina islandica* (and *Tellina balthica* in the clay). These patches are of the same kind as the masses of Lias, &c., drifted in the clay. The base is reached in boring 22 ft. on the sea shore. Over this clay is the Upper and Lower Boulder Clay. These he has now been able to trace north,

where they join and form the upper clay of Sewerby, and the basement clay gets on the cliff top between here and Dane's Dyke, and again between here and South Sea Landing. The pebbles of this basement clay are smaller, but more various. The shell beds must *somehow* have got embedded in the ice. The large masses may have drifted in several directions before settling. The basement clay can be traced on the north of Flamborough, but not very clearly. This basement clay is the earliest glacial deposit in east England, because (1) the base contains fragments of soft secondary rocks, which could not, therefore, have been covered. (2) It lies on chalk rubble. (3) There are a few local marine beds below, formed before the Boulder Clays came.

Appendix A contains a list of species from the Bridlington shell bed, including 1 Brachiopod, 55 species and varieties of Conchifera, 2 of Solenoconchia, and 64 Gasteropods. Five of these latter are extinct. They do not include *Leda arctica*, and thus indicate a warmer climate than the Clyde beds (he notes that *L. arctica* does not occur at Vancouvers, as he before stated). Sixteen out of the whole number occur at South Sea Landing. Appendices B, C, refer to the nature of the Boulders in the Basement Clay. These include igneous and metamorphic rocks, and specimens recognised as belonging to the Carboniferous, Permian, Lower, Middle, and Upper Lias (by fossils), Oolites, Kimmeridge, Neocomian, Red Chalk, Upper Cretaceous, and Subglacial. The following 15 are described by Mr. Harker: 929. Conglomerate = "Brockram;" 930. Grey dolerite; 931. Fine-grained dark dolerite; 932. Compact olivine dolerite; 933. Olivine basalt. None of these resemble the Whin Sill or other Durham dykes. 934. Altered andesite, like the Cheviot andesite; 935. 936. Augite syenites, to be matched only in S. Norway; 937. Banded gneiss; 938. Hornblende gneiss, showing pressure structures; 939. Altered biotite granite. All these three must come from far north. 940. "Binary granite" [? granulite]; 941. Medium grained two-mica granite. Not to be matched south of Scotland. 942. Red granite; 943 Biotite granite, most like that of Eskdale, Cumberland.

263. Dakyns, J. R.; Tiddeman, R. H.; Gunn, W.; and Strahan, A.—The Geology of the Country around Ingleborough.

Memoirs Geol. Survey, chapter x.

The Drift in this district is entirely composed of local rocks, and the directions of the striæ and of the long axes of the moraines are parallel to the valleys, several examples being given. A portion of the ice, however, which formed in the present Ribble basin did not go down the slope, but branched off across the watershed down Dale Beck towards

Ingleton, and on the Midland Railway, one mile south of Hawes Junction, a glaciated surface shows the striæ pointing *up* the valley. On the north side of Darnbrook Beck, and elsewhere, occurs false bedded drift gravel. The Drift rises to 2,000 ft. on the S.E. side of Ingleborough. Distinct in origin from the above, are the mounds of *débris* which curve round the steep side of Whernside. These have been produced by avalanches down the slopes.

264. Landon, J.—Note on a New Drift Section at Northfield.

Proc. Birm. Phil. Soc., vol. vii., pt. i., p. 127.

This gives an account of a road cutting from Northfield Station to King's Norton. It consists of: 1. 18 ins. of homogeneous purple clay. 2. 3½ ft. of mixed sand and clay, with small fragments of quartzites, &c. 3. 4 ft. of more stratified material of similar nature. 4. 8 ft. of gravels and clay with large erratics. This extends in a neighbouring well to 50 ft. below the surface. The erratics noted are: 1. Quartzite. 2. Permian Sandstones. 3. Purple, possibly Cambrian, Sandstone. 4. Carboniferous Sandstones. 5. May Hill Sandstones. 6. Green Sandstones, like the Hollybush. 7. Volcanic Ash, as in the Permian Breccia. 8. Conglomerates. 9. Hornstone, like that of Lilleshall. 10. Basalts. 11. Felsites of Welsh origin. 12. Mudstones. 13. Criffel Granite. 14. Limestones, various. 15. Andesites, like those of the Lake District.

265. Mitchell, T. C.—On the Drift Deposits of the Vale of Mowbray.

Proc. Yorks. Geol. and Polyt. Soc. New Ser., vol. xi., p. 177.

These are in the valley of the Swale. The author recognises boulders of siliceous rocks, Mountain Limestone, Yoredale Limestone, Magnesian Limestone, Blue Lias Limestone, and Oolite; also some schists and Shap granite, and basic rocks. Some of the Sandstones are said to contain *Lepidodendron*; also *Productus horridus* in the Magnesian Limestone, and *Ceratites nodosus* in the Bunter. [This last statement, being made quite in an ordinary way, throws doubt on the accuracy of all the identifications of rocks or fossils.] Some of the stones, when built into the walls, turn wet in damp weather, which he suggests may be due to their containing salt from their sojourn in the sea [but he has not pounded any up and tested for salt]. They also contain pholas-like cavities.

266. Whitaker, W.—Some Hertfordshire Well Sections. 2nd Paper.

Trans. Herts. N. H. Soc. Vol. vi., pt., ii., p. 53.

Fifty-two sections of wells are given, showing the thick-

ness of the various beds passed through, and, occasionally, the water level; but in five cases only the height above ordnance datum. The chief interest, therefore, in these sections, seems to be in their giving the thickness of the superficial deposits, the chalk never being pierced. The drift is not always clay. The thicknesses, when considerable, are:—Aston 77 ft.; Bishop's Stortford 50 ft.?+80 ft., or possibly 140 ft.; Cottered 60 ft.; Furneaux Pelham 77 ft., Hatfield 47 ft.; Hemel Hempstead 45 ft.; Hunsdon Bury 80 ft.?; Much Hadham 60 ft.; Thorley 80 ft.; Walkern 80 ft. and 200 ft., suggesting a channel in the chalk. One section at Long Marston gives Upper Gault 70 ft.+Lower Gault 145 ft.

267. Anon.—Note on a Section of Boulder Clay at Ashfield, between Dunblane and Kinbuch.

Stirling Nat. Hist. and Archæol. Soc., Trans. 1889-90, p. 91.

This clay is very red, and is derived chiefly from the Old Red Sandstone Rocks from the west. The boulders are of Red Sandstone, conglomerate, or Whinstone, all derivable from the same area. Under the clay is a greenish sand.

268. Nolan, J.; Cruise, R. J.; and McHenry, A.—Explanatory Memoir of Inishowen, County Donegal.

Memoirs Geol. Survey, chapters vii., viii.

The glacial deposits of this district consist of three parts. A Lower Boulder Clay rising to 1,000 ft. on the flanks of the hills; sand and gravel at an average height of 50 ft. round Lough Foyle; and an Upper Boulder Clay rising to 850 ft. The boulders are mostly from the district, but a few Antrim chalk flints occur as far as Malin Head. The glacial striæ (particularly well seen on Inch Top) have a direction between N. and N. 20° E., and others E.N.E. and W.S.W. A list of 61 places is given in which these striæ have been observed. Many indications of raised beaches at 25 ft., 50 ft., and 75 ft. are seen, often containing shells and Kitchen Middens, and the whole material, which unites the so-called "island" to the main land, is believed to be of this character, some changes having occurred within 200 years. The most important raised beaches are one on the island of Inistrahull at 50 ft., which was, however, covered with water during a storm in 1884, and one which stretches from Culdaff to Trawbreaga Bay.

269. Young, R.—Some Notes on the Upper Boulder Clay near Belfast.

Report of Belfast Nat. Hist. and Phil. Soc., 1889-90, p. 57.

Upper Boulder Clay with yew tree wood lies immediately on Keuper Marls at Ligoniel.

270. Reid, C., and Strahan, A.—The Geology of the Isle of Wight. Second edition.

Memoirs of the Geological Survey, chapter xiii.

The summits of the chalk hills are generally covered with angular flints, the relics of the denudation of the chalk, the most important patch being that on Boniface Down. That on St. Catherine's Down lies on the lower part of the flintless chalk, showing that it must have sunk to its present position by later denudation below it, after it had all formed. Over large areas on the hill tops and flanks are water-worn, mostly flint, gravels, called the Plateau gravels. They are so distributed that they must be older than the present configuration of the country, but yet are related to it, as they follow the *general*, though not the particular slopes. That is, they have a general northward slope between St. George's Down and East Cowes. They may be of Glacial or Pre-glacial age in time, as they are older than the valley gravels with *Elephas primogenius*. A vast amount of denudation has taken place since their formation, *e.g.*, 313 ft., and they resemble the Pre-glacial gravels of the Thames basin. They are described at St. George's Down to East Cowes and Osborne, Parkhurst to West Cowes, Thorness and Rew Street, Hamstead, where the gravel slopes from 200 ft. to 100 ft.; Calborne, Headon Hill, where the source is very obscure; Wootton Bridge to Ryde; Ryde to St. Helens, where the gravels may contain fossils; Bembridge, where it resembles that at Selsey, Blake Down, New Church, Alverstone, and Sandown; and finally at Brook, where it is at a lower level.

Old river terraces are found in most of the valleys, the most interesting of which is that of the Western Yar; the upper reaches of the valley have been destroyed by the encroachments of the sea on the south, and only the former tributary from Brook Bay left, which now runs out to sea. The lower reach crosses the island from Freshwater Gate to Yarmouth.

The alluvial and peat deposits of the present rivers are also described. The beds are of various character, showing changes of physical condition since the rivers commenced to erode their present valleys.

271. Abbott, W. J. L.—Notes on some Pleistocene Sections in and near London.

Proc. Geol. Assoc., vol. xi., p. 473.

The first section described is one made up from numerous manholes along a line from Fleet Street to the Embankment. The London Clay is excavated in a hollow which descends below ordnance datum, and is covered by Palæolithic gravels in which has been found a jaw of *Rhinoceros antiquitatis*

[spelt -*tus*]; on this, in a lower eroded hollow, is more recent gravel of Bronze age, covered by a limited bed of peat up to 3 ft. thick, and over all 6 or 8 ft. of dirty gravelly sand, with numerous fresh water shells, including *Dreissena* [spelt *Dreissensia*] *polymorpha*. On the other, east, side of the Fleet Ditch, the London Clay is 48 ft. higher, forming a cliff. Similar banks have been found at Hosier Lane, Smithfield, at the corner of Clerkenwell Road, and in St. Andrew Street, forming a bank of the old "Bourne." The other section described is at West Thurrock, four miles from Grays. Here there is a buried chalk escarpment, 50 ft. high, between which and the river is an old channel with a bed of sandy gravel at the base, containing foreign stones, such as quartzite, &c. Above this is 30 ft. of light brownish-grey sand, divided by a lenticular band of clay. Below this band, the sands are false bedded, above it they are not. These contain a fine suite of bones, particularly under the clay band, which has prevented their destruction. These include most of the bones of a mammoth, which tumbled over the cliff, also *Rhinoceros leptorhinus*, *Bos primigenius*, *Cervus elephas*, *Equus caballus*, *Cervus giganteus*, *Hippopotamus amphibius*, and, less commonly, *Elephas antiquus*, *Rhinoceros megarhinus*, and *R. antiquitatis*. There was also a thin band of crushed ivory, as if it had been collected and left. Over these sands, comes a clay band, 5 ft., and above this a layer of large, subangular gravel of later date, which ploughs up the clay and is itself contorted, as is the stony clay and loam on the surface—it is supposed by the action of ice. These upper beds also contain some bones of some of the species above named, and also some river and land shells.

272. Woodward, B. B.—On the Pleistocene (Non-marine) Mollusca of the London District.

Proc. Geol. Assoc., vol. xi., p. 335.

This is a corrected summary of previous observations on the land and fresh water shells, contained in sands, gravels, or earths referred to the Alluvium or River Drift of the Thames Valley. No field observations are recorded, but the materials which have been collected have, as far as possible, been examined, and the names verified, altered, or rejected; the latter usually when no specimens have been preserved. Explanatory notes are given of the various localities dealt with; not dealing with the stratigraphy, but giving the reasons for dealing with the record in the manner that has been adopted. The numerous illustrations are all old ones, borrowed from various sources. A woodcut is given of the six species which occur in these deposits, but are no longer alive in Britain, viz., *Unio littoralis*, *Corbicula fluminalis*, *Pisidium astartoides*, *Helix fruticum*, and *Hydrobia marginata*.

A table is given of which the whole paper is explanatory, stating (1) the names of all Non-marine Mollusca now or formerly British; (2) the occurrences alive in the Thames Valley, and the occurrences in the various localities in alluvium or river drift. No non-British species are admitted to the alluvium lists. [From the method of treatment, these lists must be taken as minimum ones, and no conclusions drawn from the absence of any species.]

273. Callaway, C.—Notes on the Quarternary Deposits of Shropshire.

"Midland Naturalist," p. 111.

Glacial sands and gravels occur near the summit of Grinshill Hill, and on the Longmynd, with boulders up to 1,000 ft. Also at Ketley, the sands are beautifully rippled, and contain, as in many other places, marine shells, including the cockle. [Height above sea not given.] In a sandpit in Wellington, *Waldheimia obovata* has been found, probably derived from the South and East of England. He cannot agree that these were brought by an ice sheet, with glacier lakes, &c., because sometimes stones have come from the south [the above fossil is the only one mentioned], and because of the marine shells, and doubts any ice sheet in Shropshire. [There are north to south ice scratches on Charlton Hill.]

274. Irving, A.—Note on the Plateau Gravels of East Berks and West Surrey; Their Age, Composition, and Structure.

Q.J.G.S., vol. xlvi., p. 557.

He doubts these Plateau gravels being of *later* Pliocene age only. He regards them of partly fluviatile and partly subaerial origin. The more southern portions are more angular and massive, and at a higher elevation; on the flats to the north, they are often stratified with current bedding. They range from 600 ft. to 280 ft. above ordnance datum. The only evidence of glacial action is at 400 ft., on Lodge Hill, Broadmoor, where is an unstratified gravel, with angular fragments in all positions, like the trail of a retreating snow field. In the valley gravels, below 240 ft., the evidence of ice is better shown, as at Nine Mile Ride, where the basal clays of the Middle Bagshot are finely contorted, and gravel is driven into them. In the Tangly cutting of the South Western Railway, and at Sunninghill cutting, the same folding and driving in of gravel is seen. In the Brickyard north of Bracknell there is unstratified clay, with erect pebbles. He regards the Plateau gravels as marking the drainage courses of the later Tertiary valleys, while the present valleys have been initiated in places where these are absent, the gravels having preserved the hills from de-

nudation [a power such gravels are not generally credited with], this denudation having occupied the interval between the Plateau and the lower gravels, the latter being formed in the Glacial epoch. He asserts [but gives no evidence for] his belief that the earliest Plateau gravels were contemporaneous with the Lenham deposits.

275. Shrubsole, O. A.—On the Valley Gravels about Reading, with Especial Reference to the Palæolithic Implements found in them.

Q.J.G.S., vol. xlvi., p. 582.

The gravels referred to are those below 300 ft. above ordnance datum. On the north side of the Thames, such gravels are found at: 1. Toots Farm, Caversham. Here are 8 ft. of subangular flint gravels, with quartz, &c., from Triassic rocks. Palæolithic implements are found 1—3 ft. from the surface. They are not much worn, are of a sharp-pointed type, and vary in workmanship. Fragments of quartz are found, hollowed at the edge. This, being at 235 ft. above sea level, and 114 ft. above the river, is the highest trace of man yet found in the district. 2. Henley Road, Caversham. In a thin patch of sandy gravel, at 168 ft., a flat, ovoid implement has been found. 3. Shiplake. There is a gravel terrace at 200 ft., with implements like those at Toots Farm. On the south side of the Thames, gravel is noticed at Islehurst Road, Reading. It is here 22 ft. thick, and contains ochreous masses, and chalky masses at the base, with ochreous gravel above, capped by whitish clayey gravel. This lies on Reading sands, and is about 75 ft. above the river, lying on the watershed between the Thames and Kennet. The lower masses may be brought by floating ice, or the chalky gravel may be earlier. Worn implements are found here, of various tints; one, with the patination almost obliterated, but different from the rest, may be derived from an earlier gravel. Some implements are made of quartzite, indicating a manufacture subsequent to the glacial dispersion. The characteristic forms are ovoid, but damaged pointed ones occur. Mammalian remains are associated with them. 2. Norcot Brickyard. 6 ft. of small flint gravel, with many foreign stones, occur at 288 ft., without implements. 3. Redlands, Reading. At 156 ft. and 40 ft. above the Kennet, in a thin sheet, is a varied collection of implements. 4. Kennet Mouth. 16 ft. of gravel resting on chalk, at 30 ft. above the river, with mammoth, but no implements. 5. Southern Hill and Earley. A flint gravel, 7 ft. thick, at 212 ft. up, with a few flakes. 6. Sonning Hill on the Thames, and Loddon Watershed, at 185 ft. The gravel is clayey and ochreous, 10 ft. thick, with a few ovoid implements. 7. Charvil Hill, Sonning, at 171 ft., shows bedded

gravel, with rare implements. 8. Ruscombe, Twyford. The gravels are at two levels, the higher at 167 ft., and 60 ft. above the Thames. Implements of various types occur, some sunk into the Reading Clay beneath. The lower belongs to the Loddon. These evidences show that the works of man do not occur in the highest gravels, either north or south of the Thames, nor in the lowest. Man was, therefore, present betwen the times when the river was 114 ft. and 40 ft. above its present level, but not necessarily continuously. [It seems to be assumed that his supposed absence, at earlier and later periods, was due to glacial conditions.] The mammals may have remained longer.

276. Dalton, W. H.—Note on the Upminster Brickyard, 1890.

"Essex Naturalist," vol. iv., p. 186.

The pit is in the river drift, 150 ft. above O.D. It shows loams and gravel alternating, the arrangement being very irregular, but not requiring ice action to explain it.

277. Reade, T. M.—Note on some Mammalian Bones found in the Blue Clay below the Peat and Forest Bed at the Alt Mouth.

Proc. Liverpool Geol. Soc., vol. vi., pt. ii., p. 218.

These consist of numerous bones of the Red Deer and some bones of Horse, and they are undoubtedly *in situ*.

[278]. Cole, E. M.—On Peat Overlying a Lacustrine Deposit at Filey.

Paper read to the British Association on Sept. 10, but not published in 1890.

279. Foord, A. H., and Kidston, R.—Notes on the Fauna and Flora of the Pleistocene Beds in the Carse of Stirling.

Trans. Stirling Nat. Hist. and Archæol. Society, 1889-90, p. 91.

These beds have been long ago described by J. Haswell (Trans. Edin. Scot. Geol. Soc., vol. ii., pt. i., 1872), and the authors have added the following species to his list:—*Ocinebra* (*Murex*) *erinacea*, *Chrysodomus* (*Fusus*) *antiquus*, *Littorina obtusata*, *Cardium exiguum*, *Scrobicularia prismatica*, *Lepralia Peachii*. These are all still living in Scottish seas.

280. Scott, T.—Preliminary Notes on Post-Tertiary Freshwater Deposits at Kirkland, Leven, and at Elie, Fifeshire.

Proc. Roy. Phys. Soc., Edin., 1889-90, p. 334.

The first of these is a marl overlaid by 6 ft. of sand and gravel, and formed in a rather deep lochan like Corstorphine Loch. Small mollusca occur, also *Erpetocypus strigata*, *E. tumefacta*, *Cyprois flava*, and other entomostraca still living in Duddingston Loch. The Elie deposit is by the railway

station, and is a dark-brown marl. 17 mollusca and 7 ostracoda are given as found here, which indicate an open marsh. The *Scottia Browniana* is an ostracod first found as a fossil at Clacton, but later found living in Loch Fad by the writer. A synonymy of the ostracods is given.

281. Praeger, R. L.—On the Gravels and Associated Beds on the Curran, at Larne, co. Antrim.

Rep. Belfast Naturalists' Field Club, 1889-90, p. 198.

These gravels are noted for their flint flakes and cores, and a special section has been dug in them under the care of a committee. The beds seen are—A. and B. Surface soil at 22 ft. above high-water mark, then 6 ft. of coarse gravel, well stratified, and with fragile littoral shells. C. Fine gravel and sand, 3 ft. 6 in., with *Tapes decussatus*, *Ostrea edulis*, *Lucina borealis*, having their valves joined. The basal zone is 9 in. thick, with *Littorina littorea*, *L. obtusata* D. Coarse gravel, 8 ft. 6 in., dipping 25° to W., with many shells, *Littorina* being the most abundant. E. Black clayey gravel, 2 ft. 6 in., otherwise similar to the overlying. F. Coarse black sand, 1 ft., with *Tapes aureus* and *Cardium exiguum*, common. G. Typical Estuarine Clay, tough, homogeneous, and blue, with abundant *Zostera*, thickness not stated. H. Fine blackish sand, 2 ft. *Littorina obtusata* and *Trochus cinenarius* are most abundant. I. Coarse blackish gravel, with large rounded boulders up to 2 ft., covered with *Spirorbis* and corallines—abundant *Littorinæ* in the matrix. Each of these beds, from A to E, has yielded worked flints, the bed D yielding about one for each $\frac{1}{100}$th of a cubic foot. A list of the species of mollusca, &c., from the beds G H and I is given. The paper has a diagrammatic section drawn to scale, and a photograph of the gravel escarpment.

282. Praeger, R. L.—A Contribution to the Post-Tertiary Fauna of Ulster.

Rep. Belfast Naturalists' Field Club, 1889-90, p. 215.

This gives a list of 20 species from the "Estuarine Clay" which have not been recorded before, even in the list in the same journal.

283. Kidson, E.—Further Evidences of Glacial Action in Snowdonia.

Trans. Nott. Nat. Soc. for 1889, p. 14.

He notices a moraine in a valley four miles south-east of Aber. It is at the lower end of a lake; one block measures 14 ft. by 8 ft. by 12 ft., and is of felspathic character. By Llyn Idwal, in the valley of the Ogwen, there is a rounded rock quarried, overlaid by moraine matter. Another moraine stretches across the mouth of the valley. There is also a striking group of boulders, south-east from the outlet

of the lake, some of which stand on end, and one is 12 ft. by 12 ft. by 9 ft. Another moraine heap, 50 ft. above Lake Idwal, shows a rock 19 ft. by 12 ft. by 13 ft. At the south end is a large mammillated mound, and also others between this and the Gribin. A little further up the valley is a long moraine mound and smoothed rock, 200 ft. above Lake Idwal. Due east from the summit of Y Garn, are some blocks, with their lower sides facing north, showing the motion of the glacier in that direction. Closer to the edge of the Lake the striæ run N. 10° W. On both sides of the stream from Cwm Clyd, entering Lake Idwal, the striæ bear N.E. by 10° E., also parallel to the stream. These are tributary glaciers. On the western side of Lake Idwal the moraines are most conspicuous in three or four lines. On the spur of Glyder-fawr, glaciation may be traced to a height of 2,000 ft. At 700 ft. lower there are many perched blocks on the Llanberis slopes. Part of the ice went towards Llanberis, and part to Capel Curig, and some over the watershed to Nant Gwynant.

A mile beyond Cwmglas Bridge, are grooves 2 ft. across and a foot deep, sloping at an angle of 6°. Other grooves are seen 75 ft. above the road at the "office." Other signs of glaciation, as perched blocks, are traced down as far as Llanberis. Beyond Cwm-y-glo, 150 ft. above the road, is a rounded, glaciated mound, proving the glacier to have extended to 4½ miles from Carnarvon. On the side of the hill, by Glyn slate quarries, *débris* can be traced up to 750 ft. above the lake, giving the thickness of the ice of which these *débris* were the lateral moraines.

In Cwm Glas Bach, ice-worn rock is seen at 700 ft. above the nearest point of the river of the Llanberis Pass, giving this as the least thickness of the ice higher up. On the east of Snowdon, by Lake Llydaw, on the eastern side, are grass-grown moraine heaps. All the rocks up to the shoulder of Crib-goch are well glaciated, with grooves running parallel to the ridge. In the upper part of Cwm Dyli, the grooves show that the glacier must have passed east over the Gribin. Near the Llanberis track to Snowdon, there are good signs of glaciation. Near the half-way house, the valley contains a great moraine heap, the largest block being 65 ft. by 35 ft. by 26 ft.

284. Whitaker, W.—On a deep Channel of Drift in the Valley of the Cam, Essex.

Q.J.G.S., vol. xlvi., p. 333; also Rep. Brit. Ass. for 1889, p. 588.

Examples are first given of places in which great depths of drift are found by borings in close proximity of masses of chalk at or near the surface. At Rickling the

chalk at various spots is only found at depths of 83 and 60 ft., though outcropping not far off. At Quendon the depth of drift sand, &c., is 80ft. +, 97 ft., 90 ft., though not far off it is only 18 ft., or the chalk actually crops out. At Newport there is 75 ft. of drift within 150 ft. of a chalk outcrop, showing an underground slope of the chalk surface of 1 in 2. Another well passed through 340 ft. of loamy beds without reaching chalk, which crops out at 1,000 ft. away, showing a slope of 1 in 3, and the drift descending 140 ft. below sea level. At Wenden there is a boring with chalk at 296 ft. down, and 420 ft. away it is within 3 ft. of the surface, showing a slope of 1 in 1·43. The special example is then treated of. It occurs at Littlebury. Numerous borings show the chalk at 3, 6, 4, and 15 ft., but along a certain band the borings show drift to 218 ft. This gives, for a distance of 180 ft., a slope of 1·2 in 1. This band is a narrow one, and the author considers it is not due to faulting or chemical agencies, but to a previous erosion of a channel. The "Drift" is chiefly loam.

285. Holmes, T. V.—The Channel of Drift in the Valley of the Cam.

"Essex Naturalist," vol. iv., p. 117.

A notice of Whitaker's paper on this subject, as above.

286. Bennie, J.—Note on a Recent Exposure of a "Washout" of Strata in New Redhall Quarry.

Proc. Roy. Phys. Soc. Edin., 1889-90, p. 392, plate xvi.

The quarry shows carboniferous sandstone and shale nearly horizontal at the east end, which are irregularly truncated towards the west, and the cavity filled with very irregular Boulder Clay, the boulders mostly at the bottom and on the slope; over all is more uniform Boulder Clay. It shows disturbance and water action, which has eroded this channel in the middle of the Glacial period.

287. Lamplugh, G. W.—Report of the Committee appointed for the purpose of Investigating an Ancient Sea-beach near Bridlington Quay.

Rep. Brit. Ass. for 1889, p. 70.

Nothing has been done beyond preparing specimens previously obtained.

[**288.**] **Lamplugh, G. W.**—Final Report of the Committee for Investigating an Ancient Sea-beach near Bridlington Quay.

Read to the British Association in September, but not published in 1890.

[**289.**] **Hind, W.**—The Glacial Period and its Vestiges in North Staffordshire.

[**290.**] ——— ——— Discovery of a Pre-glacial River at Milton.

Papers read to the North Staffordshire Naturalists' Field Club and Archæological Society on Feb. 20 and Nov. 20, but not published in 1890.

[**291.**] **Woodcock, W. H.**—The Ice Age in North Wales.

Paper read to the Warrington Field Club on Nov. 21, but not published in 1890.

[**292.**] **Kendall, P. F.**—On the Glacial Phenomena of the Isle of Man.

Paper read to the British Association on Sept. 5, but not published in 1890.

[**293.**] **Smith, J.**—The Great Ice Age in the Garnock Valley.

Paper read to the Geological Society of Glasgow, Jan. 9, but not published in 1890.

[**294.**] **Thomson, J.**—The Glen Clova Glaciers and Ice Action in Central Forfarshire.

Paper read to the East of Scotland Union on July 23, but not published in 1890?

295. Pidgeon, D.—On certain Physical Peculiarities exhibited by the so-called "Raised Beaches" of Hope's Nose and the Thatcher Rock, Devon.

Q.J.G.S., vol. xlvi., p. 438.

The author mentions fourteen peculiarities of these deposits. (1) All the fragments are angular; (2) The rocks are almost entirely of the limestone of the cliff above; (3) There are very few rounded pebbles; (4) The other stones are local, and are not rounded, or if previously rounded are now broken; (5) A few of these are encrusted with annelid tubes; (6) The limestone fragments are not so encrusted; (7) The broken limestone pebbles are bored; (8) Half the mass is shelly; (9) The shell fragments are sharply angular; (10) The bulk of the shells are unbroken *Littorinæ* and *Purpuræ;* (11) The bivalves are broken; (12) Their sculpture is unworn; (13) They have no annelid encrustations; (14) Some are of Northern species. He accounts for these facts by supposing there was an ice foot here, in which the fragments and shells were frozen, and when this melted a trench was formed, and the sea tossed into it some of its own *débris*. There are, however, no scratches, and there are also Southern shells; but he does not think the fragments could be thrown up so far by the sea as it now is.

296. Pengelly, Wm.—An Old Man and Woman—or Human Bones in a *Scrobicularia* Bed at Newton Abbot, Devonshire.

Trans. Geol. Soc. Edin., vol. vi., p. 37.

At an excavation for gas works, under 2 ft. of soil was found 11 ft. of fine dark sandy mud, underlain by gravel.

In this mud were innumerable *Scrobicularia piperata* and oysters, and at 1 ft. from the bottom (*i.e.*, 10 ft. down) some scattered human bones. These belong to a man and a woman of *Brachycephalic* type. The top of this bed is 13 ft. above spring-tide low water, and the level can never be reached by salt water, as the living shells are found only at low water; this shows a rise of at least 13 ft. He concludes these bones probably did not sink through the mud, but were living soon after its formation began, especially as an iron key was found 1 ft. from the top.

[**297.**] **Somervail, A.**—On the Raised Beaches at Hope's Nose.

Paper read at the Torquay Natural History Society on October 29, but not published in 1890.

298. Whiteley, N.—A Geological Note.

Trans. Roy. Geol. Soc. Cornwall, vol. xi., p. 242.

Boulders are found in a sandy loam near the Penzance School of Art, indicating a raised beach.

299. Bell, A.—Notes upon the Marine Accumulations in Largo Bay, Fife, and at Portrush, co. Antrim, North Ireland.

Proc. Royal Phys. Soc. Edin., 1889-90, p. 290.

The first of these accumulations are current-bedded sand-banks of the laminarian zone, now raised above shore level, and are not, therefore, sea-*beaches* in the proper sense of the term. The author gives a list of the Mollusca, Foraminifera, and Ostracoda, numbering 132, of which 19 are not now known to be living in the Firth of Forth. The deposit at Portrush is similar, and he gives a list of about 130 forms.

300. Miller, H.—Note on Supposed High-Level Shell Beds in Easter Ross.

Trans. Geol. Soc. Edin., vol. vi., p. 28.

Notes that beds supposed to contain arctic shells are nothing but heaps of modern mussels and limpets, covered with blown sand.

BOULDERS.

301. Crosskey, H. W.—Seventeenth Report of the Committee appointed for the purpose of Recording the Position, Height above the Sea, Lithological Character, Size and Origin of the Erratic Blocks of England, Wales, and Ireland, reporting other matters of interest connected with the same, and taking measures for their preservation.

Rep. Brit. Ass. for 1889, p. 115.

The records in this report are chiefly from Yorkshire. (In the following abstract S. = small—*i.e.*, less than 10 cubic ft.;

L. = large; the feet stated are above sea level.) 1. Strensall, Carboniferous Sandstone, L. 100 ft. 2. Ditto, 20 S. 3. Flaxton, Mountain Limestone, L. 120 ft., called the "Rambleations Stone." 4. Ditto, M. Limest., L. 120 ft., a boundary stone. 5. Ditto, M. Limest., L. 150 ft. 6. Burniston, Scarborough, Shap granite, L. 7. Seamer, whin and sandstone, six S., 120 ft. 8—15. Muston, Filey, sandstone, granite, and whinstone, 12 S.; whinstone, S. 150 ft.; whinstone and sandstone, whinstone, 20 S., 150 ft.; several small, various, whinstone, L. 150 ft.; granite, S., 20 or 30 large and small, various. 16. Foss Island, York, M. Limest., S. 17. Whitby, M. Limest., L. on sea shore, fallen down. 18—23. Foston-le-Clay, granite, L. 200 ft., S. 150 ft.; Shap granite, L. 150 ft., 100 small, various; 3,000 small, various; 20 small, various. 24—29. Thornton-le-Clay, M. Limest., S. 150 ft.; sandstone, &c., 200 small, and a footpath paved with small boulders, mostly Carboniferous sandstone; M. Limest., S., 150 ft.; Carboniferous, 1,100 small, 150 ft.; M. Limest., S. 250 ft. 30, 31. Staxton, Scarborough, Carb. sandst., S. 180 ft.; whinstone, S. 120 ft. 32, 33. Flixton, Filey, Carb. sandst., S. 150 ft.; various, 7 S., 120 ft. 34, 35. Hunmanby, sandstone, L. 100 ft.; whinstone and sandstone, 14 S. 36. Bridlington, sandstone, 3 L. and 8 S.; whinstone, 1 L. and 2 S.; Shap granite, 2 S.; dolerite, 1 S.; and M. Limestone, 1 S., 100 ft. 37. East Lutton, whinstone, S. 38, 39. Driffield, whinstone, S., various, 12 S. 40. Reighton, whinstone, S.; Tanfield, M. Limestone, very large; Thornborough, gritstone, L.; Manfield, N. Riding, felspathic trap, very large, called the "Greystone." An analysis is given by **W. F. K. Stock**:—Silica, 59·87; Alumina, 16·17; Ferrous Oxide, 3·60; Ferric Oxide, 1·83; Manganous Oxide, 0·43; Lime, 4·57; Magnesia, 3·35; Potash, 1·48; Soda, 2·73; Carbonic Acid and Water, 6·50.

At Neswick, East Riding, are one large and three small basalt boulders, and a small one of siliceous limestone. In Strinesdale Valley, South West Riding, are small boulders of Silurian grits, Lake District syenites, &c., with local grits, from 740 to 830 ft. In Castleshaw Valley are only a few small syenite and Eskdale granite boulders. Near Water Mill, a large one of hornblendic trap 700—1,200 ft. In Denshaw Valley, small ones of syenite and dolerite, 940 ft., Boulder Clay ceasing at 850 ft. In Robin Hood's Bay are 3 groups, 1st, 24 small whinstones, and 7 of grits, Mountain Limestone and dolerite; 2nd, 2 small of sandstone, and one large of felspathic trap in a stream; 3rd, in Millbeck, 2 small of sandstone, 1 small of gneiss. and one large of whinstone. At Marton-cum-Grafton are two large boulders of Shap granite 100 ft. At Staveley the largest is M. Limestone, and

a small one of Shap granite 100 ft. At Arkendale one large and several small of M. Limestone 180 ft. At Claro the largest is M. Limestone at 230 ft. On Whitby West Sands is a large Shap granite boulder. At Runswick Bay are 3 large of Shap and one of grey granite. At Southbourn, Driffield, a large whinstone boulder 100 ft.

The "Fourstones" and "Haddockstones" near Ripon are not boulders, but weathered *in situ*.

At Harton, South Shields, Durham, 1 large, 2 small, and a large one called the "Preaching Stone," of Whinstone 50—60 ft.

On Seat Naze, Whalley, a large boulder of quartzose Borrowdale Agglomerate called the "Bellstone," 960 ft.

[These Records are obviously inserted in the Report just as received, with no attempt at classification.]

[**302.**] **Crosskey, H. W.**—Eighteenth Report of the Committee for Recording the Erratic Blocks of England, Wales, and Ireland, &c.

Read to the British Association in September, but not published in 1890.

303. Lamplugh, G. W.—On the Larger Boulders of Flamborough Head. Pts. ii. and iii.

Proc. Yorks. Geol. and Polyt. Soc., New Ser., vol. ii., p. 231.

This gives a list of varieties of boulders over 1 ft. in diameter, found, 1st, in Dane's Dyke; 2nd, on the shore between this and South Sea Landing. Of the former 142, and of the latter 110, are counted. The percentages are as follows:—

	Dane's Dyke.	Shore West of South Sea Landing.
Carboniferous Limestones	17·6	18·2
Carb. Sandstones ..	3·5	7·3
Doubtful Limestones ..	5·0	2·7
Doubtful Sandstones ..	21·8	22·7
Primary Quartzite ..	1·4	5·5
Lias Limestone ..	0·7	—
Basaltic	43·7	37·3
Schistose	1·4	3·6
Granitic	3·5	2·7

A comparison of a total of 328 (including 76 east of South Sea Landing) with 500 from the shore at Tunstall, near Withernsea, 30 miles south, gives the following result:—

	Flamborough.	Tunstall.
Carboniferous Limestones (including doubtful)	20·0	22·8
Sandstones.—Carboniferous, &c.	39·0	14·4
Secondary Rocks	0·3	22·1
Basaltic	34·0	37·4
Gneiss and Granite	6·7	3·4

These figures only refer to blocks over 1 ft. in diameter,

and may therefore record rather the toughness of the rock, than their frequency in the Boulder Clay.

[**304.**] **Lamplugh, G. W.**—On the Boulders and Glaciated Rock Surfaces of the Yorkshire Coast.

East Yorkshire during the Glacial Period.

Papers read to the British Association on Sept. 4, but not published in 1890.

305. Hobson, B.—On some Ophicalcite Erratics at Barton-upon-Irwell.

Trans. Manch. Geol. Soc., vol. xxi., p. 84.

These have been used for a mill foundation which is now broken up by the Manchester Ship Canal. One is 4 ft. 8 in. by 3 ft. 2 in. by 1 ft. 6 in., the other, 2 ft. 9 in. by 2 ft. 3 in. by 2 ft., and both are angular. They consist of contorted ophicalcite in bands of black and grey with green patches. There are three similar ones built into an old lock near the spot. He speculates on where they could have come from. Ophicalcite from Connemara would be carried westward; that from Anglesey, which resembles these, would be carried S.S.W.; but they may possibly have come from the western islands of Scotland [or by human agency].

306. Reade, T. M.—Note on a Boulder met with in driving a Sewer-heading in Addison Street, Liverpool.

Proc. Liverpool Geol. Soc., vol. vi., pt. ii., p. 188.

This boulder occurs in the clay with sandy seams. It is a mass of volcanic tuff 4 ft. 10 in. by 3 ft. by 2 ft. 6 in. The interest of it lies in the fact that its long axis has a direction N. 35° W., which is the same as the direction of the glacial groovings and striations on the Triassic rocks near Liverpool.

307. George, J. E.—Microscopical Examination of two Glacial Boulders.

Proc. Liverpool Geol. Soc., vol. vi., pt. ii., p. 197.

One is from Pen-y-bont, Ruabon. It is a red granite boulder, 12 in. in diameter, with micropegmatitic structure, and may be matched in N. Wales, whence it probably came. The other is in the Mayer Grounds, and was brought from Raby Mere, Cheshire. It is an ordinary felsite, with no special characters to indicate its source.

[**308.**] **Antrobus, J. C., and Hatch, F. H.**—Preliminary Note on the Composition and Origin of Cheshire Boulders.

Paper read to the British Association on Sept. 8, but not published in 1890.

309. Stirrup, M.—The Large Boulder near Ringway.

Trans. Manch. Geol. Soc., vol. xxi., p. 83.

This Boulder measures 11 ft. 6 in. by 7 ft., and is 40—45 in. deep from the ground, but more may be buried. It rests on red clay, and is apparently a Lake District volcanic ash of a dark greenish blue colour.

310. Hollingworth, G. H.—On a Tree Branch found in the Drift.

Trans. Manch. Geol. Soc., vol. xx., p. 566.

This was found at a depth of 40 yards in sinking a pit (No. 1) at Lingard Lane, Bredbury, and there are five yards more of drift consisting of marl, sand, and loam, making a total of about 140 ft.

[**311.**] **Horsfall, J.**—Erratic Blocks in the District of Rochdale.

Paper read to the Rochdale Literary and Scientific Society, but not published in 1890.

[**312.**] **Harrison, S. N.**—Boulders round the Manghold Coast.

Paper read to the Isle of Man Natural History and Antiquarian Society on December 2, but not published in 1890.

313. Martin, J. W.—The Boulders of the Midland District.

Proc. Birm. Phil. Soc., vol. vii., pt. i., p. 85; with a folding map.

This map shows an area of some 1,600 square miles. It indicates the positions of boulders, of which a list is given at the end, occupying 22 pages. The sources of the boulders, whether from Criffel, Lake District, Arenig, or Rowley Regis, are indicated by distinctive marks. The north-western and central portion is occupied entirely by the two former. They are not limited by the hills, but spread over hill and dale alike. They fringe off on a line curving from Much Wenlock, round Burton, Bridgnorth, Enville, Harborne, Edington, Sutton, and Burntwood to Colton. Beyond this, to the south-east, are the Arenig boulders, those from Rowley Regis being quite local. This shows that the Welsh boulders, which, when large, are quite angular, were deposited first, and we only see the margin of the deposit, the later boulders not entirely taking their place, only overlapping at Sutton Coldfield. He can find no sign of a crossing of Eskdale and Criffel Granite as stated by Macintosh.

314. Brown, J. A.—Note on a Sarsen Stone at Hanwell.

Rep. of Ealing Microscopic Soc. for 1889, p. 14.

A block, 3 ft. 7 in. by 2 ft. 9 in. by 1 ft. 3 in. or more in depth, is seen in the gravel pit close to Hanwell Station. The beds above are unstratified, and it has been brought there by ice from the west.

GLACIAL THEORIES.

315. Argyll, Duke of—Border Lands between Geology and Geography.

The Scottish Geographical Magazine, April, 1890, p. 169, with Map of Greenland.

The author gives a *résumé* of recent knowledge about Greenland, pointing out that, in spite of its favourable conditions, the Humboldt Glacier is the only large mass which reaches the sea. The icebergs broken off are comparatively small. These facts appear to the writer to be an argument against the ice of the Glacial period doing any more than the Greenland ice. He concludes also that the work of such an ice sheet must be all over the surface, but the marks of glaciation observed in Scotland are local and one-sided; and he concludes that the British glacial phenomena can only be accounted for by small local glaciers and floating ice, under a submergence. He does not think the Moel Tryfaen shells have been pushed up, nor the high level gravels to be river gravels [but in no case does he produce any evidence for his conclusions].

316. Watt, James.—Theories of the Ice Age, and Notes on the Glacial Geology of the Immediate Neighbourhood.

Transactions, &c., of Dumfries and Galloway Nat. Hist. and Antiq. Soc., No. 6, p. 85.

The theoretical part is merely a quotation from Croll. At the railway bridge below Dalbeattie, boulder clay was met with for 25 ft., underlaid by an earth surface of soil and hazel nuts. [Was the boulder clay re-constructed ?]

[**317.**] **White, J.**—My Ideas of the Great Ice Age.

Paper read to the Geological Society of Glasgow, Feb. 13, but not published in 1890.

CAVES.

318. Speight, H. — Discovery of a Bone-Cave at Skirethorns, near Grassington, in Craven.

"Naturalist," p. 202.

This is at a place called Height, a mile west of Skirethorns. It is filled with stiffish clay, with numerous bones. It extends more than 12 yards, and the entrance at present is only 3 ft. high. It is on the west face of a north and south cliff, 1,200 ft. above O.D.

319. Tiddeman, R. H.—The Geology of the Country around Ingleborough.

Memoirs Geol. Survey, p. 33.

The caves in this district are exceptionally numerous, the circumstances being favourable for their production. They are as follows:—

Gate Kirk Cave.—The Dale Beck loses itself in the lime-

stone fissures at Ivescar End Moss, and comes out again from a tunnel-like cave facing down stream.

Weathercote Cave.—This is a pair of "pots," or underground stream cavities, whose roofs have fallen in and which are connected below. The stream is seen to come out of the rock halfway down the side, and to have a fall of 75 ft. for the rest of the depth.

Jingle Pot.—A chasm in the overflow channel lower down, *up* which at the last flood great fragments were brought.

Hurtle Pot is a similar hole, with water at the bottom.

Douk Cave is the course of an underground stream, whose roof has partly fallen in. Up the cave a deep natural shaft is found opening to the light overhead, where it is called Little Douk Cave, and where the water may be heard rushing below.

Braithwaite Wife Hole is a smaller broad pot.

Alan Pot is a hole on Sinon Fell, 216 ft. deep, down which the stream plunges and runs away along a cave at the base. The drops of water falling vertically undisturbed have fluted the sides.

Gaping Gill and Ingleborough Cave.—The first is where the water falls in which comes out at the second. It is a cavity 360 ft. deep, into which any sized flood can be taken. The old overflow stream is now, therefore, constantly dry; and at a lower level are found two earlier-formed pot holes, one called Bar Pot. Ingleborough Cave has been described by Farrer and Phillips. It has been explored for 700 yards. The river does not usually flow through it, but at the end may be heard falling down a fissure to a lower level. But it has made dams of Travertine, which pond back pools, and the water from the sides keeps the barrier level. The upper parts were originally cut off by such a dam, and the level at which the water stood may be seen by a "dado" of tufa. The Pillar Hall, Beehive, Ladies' Cushion, Long Gallery, and Giant's Hall are noticed. In one place, there are vertical plates of tufa, which ring when struck.

Another cave is *Yordas Cave.*

320. Smith, J. P.—On Dunald Mill Hole.

Read to the Barrow Naturalists' Field Club on November 11, 1889. Printed in 1890.

This is an account of the exploration of a cave whose entrance goes by the above name. It is situated in the hills above Carnforth, and is in the Mountain Limestone. He gives a very graphic account of the difficult exploration, the passage being, in places, no more than 12 inches high. The cave is at first pretty high, but varies in breadth; thence a low passage leads to a small cave with a stalagmite, which he calls the "Boss Chamber." The passage then curves greatly

and is very low, hence called the "Narrow Way." It reaches another cave, the "Pulpit Chamber," after which comes the lowest passage leading into a larger "Far Chamber," beyond which a passage only leads to water. From the entrance to the "Narrow Way" is 74 yards, to the end of the "Far Chamber," 115 yards—total, with the passage beyond, 120 yards. A section and plan are given, also a map and section of the country. The water that falls into this hole is generally lost, but there are three outlets lower down, the lowest is Netherbeck Spring, the next Brewer's Barn Hole, and the highest, out of which the water only comes in flood time, "Dingle Pot Hole." All the water ultimately finds its way into the river Keer.

321. Fitzpatrick, J. J.—Recent Discovery of a Bone Cave at Deep Dale, near Buxton.

Proc. Liverpool Geol. Soc., vol. vi., pt. ii., p. 200.

Deepdale is a wild rocky gorge near Kistorndale, about 3 miles from Buxton. It is about a mile in length and 100—200 yards broad. The deepest part is 900 ft. above sea-level, and the rocks at the side sometimes rise perpendicularly for 160 ft. The cave is situated about ¾ mile from the Bakewell Road and ½ mile from the London Road, on the left going from the latter. The entrance to the cave is about 20 ft. above the stream, and the height of the cliff above is about 140 ft. It is marked on the 6 in. map. It runs horizontally due east. This has been explored by William Millett of Buxton. In the second chamber, he broke through the stalagmite at the bottom and found another cave below. Descending into this by a rope, he found a fourth with a very low entrance from thence into a fifth, and finally a sixth, with a well at the bottom 6 ft. deep. The size of these various caves is as follows:—1. 93 ft. long, 10—20 ft. wide, and 6—12 ft. high; 2. 73 ft. by 12—20 ft. by 3 to 12 ft., rising in one part to 35 ft.; 3. 17 ft. by 4 ft. by 7 ft.; 4. 19 ft. by 3 ft. by 3 to 5 ft.; 5. 49 ft. by 6 ft. by 8—12 ft.; 6. 13 ft. by 10 ft. by 9 ft. This makes a length of 264 ft. in all. In the second chamber, he dug a hole 8 ft. deep and obtained the following section downwards:—1. Dark clay, with limestone fragments, containing Roman pottery, a bronze pin and locket, a bone pin and remains of stag, horse, sheep, goat, and boar, 3 ft.; 2. Broken fragments of limestone, &c., with a human lower jaw and several small bones 6—18 inches; 3. To the bottom, stiff yellow clay, with pebbles, pointed for use as hammers, and a stag's horn. In the fourth chamber were found a skull of *Bos longifrons*, the antler of a stag, and a bone spear-head. In the fifth, the skulls of *Sus scrofa* and *Ursus arctos*, the latter embedded in stalagmite. Bones and teeth have also been found of *Cervus tarandus* and *C. elephas.*

In the upper chambers were also found pottery, Roman and Samian, charcoal, cut stag horn, bones of birds, sheep, and goat, and a Roman coin, A.D. 250. The whole of the remains have been deposited in the Buxton Town Museum.

322. Jones, E.—On Further Exploration of a Cave at Elbolton, near Thorpe, in Craven.

Proc. Yorks. Geol. and Polyt. Soc. New Series. Vol. xi., p. 307.

This is now worked systematically by a committee. There is a thickness of 4—15 ft. of loose stuff, and a pot hole of clay near the entrance, in which jaws of *Ursus ferox* have been found. The main contents as yet found are two human skeletons, buried in a bent position. The skulls are dolicocephalic. There are no flint implements, but numerous undetermined bones, mostly broken for the marrow; charcoal, pottery, bone pins, &c., also occur. It was a place of habitation in the Neolithic period, still showing the polished footholes.

[**323.**] **Jones, E.**—The Results of Recent Exploration in a Cave at Elbolton, in Wharfedale.

Paper read to the British Association on Sept. 8, and also to the Bradford Scientific Association on Oct. 17, but not published in 1890.

324. Laing, R.—On the Bone Caves of Cresswell, and Discovery of an Extinct Pliocene Feline (*Felis brevirostris*) new to Britain.

Rep. Brit. Ass. for 1889, p. 582.

He has found remains of Wild Boar in the Dog Hole. In Robin Hood Cave he has found, in the south-west corner, an oval cairn, 20 ft. long, of stones and earth, over a fissure 21 ft. deep, terminating in a cavern, and both filled with unfossiliferous red sand. The Palæolithic beds crossed over the top of the fissure. The cist was constructed of stone slabs of enormous size, sunk through the fossiliferous beds into the red sand. A *radius* and *humerus* were all that remained of the skeleton, and an elaborately-chipped flint occurred with it. This is of Neolithic age, as it sealed up the entrance to a deposit of Neolithic age. The Pleistocene deposit was covered with 6 or 8 in. of stalagmite. It contained the same fauna as in the front cave, with the addition of *Felis brevirostris*, Croizet and Zobert, represented by two mandibles, a maxilla, and a radius. The mandible has the characteristic prolongation of its lower border, which ends in a tubercle projecting below the level of the jaw. The incisors are wanting, but the alveolus indicates the presence of an unusually large one next to the canine on its inner side as in the type. The maxilla is unique; it has only three molars, the anterior tubercular premolar being absent, and no alveolus appearing. The canine tooth is enlarged, apparently in compensation. The

anterior palatine foramen perforates the palate further back than in existing cats. The length of the mandible is 4½ in., and of the maxilla 2·8 in. The radius is 6¾ in. long. Other detailed measurements are given.

At the rear of Robin Hood Cave is a natural tunnel 18 ft. long, filled with red sand, leading to a cave 50 ft. long, 30 ft. broad, and 11—27 ft. high, silted up to near the roof. At the base is stiff red clay and ferruginous sand with *Hippopotamus major*, *Rhinoceros leptorhinus*, *Bison priscus*, *Cervus alces*, *Sus scrofa*, *Canis lupus*, *Ursus*, *Hyæna crocuta*, and *Arvicola amphibia*. Occupation by man is shown by "pot boilers," charcoal, and rude flints. On the floor of the cave, beneath a great block of limestone, were fragments of a human skull and fibula. In the middle of the cave, an artificial pillar of limestone blocks had been erected to prevent the fall of the roof. The earliest occupation was probably Pre-glacial.

MIXED LOCAL GEOLOGY.

325. Topley, W.—The Work of the Geological Survey in Northumberland and Durham.

Rep. Brit. Ass. for 1889, p. 597.

This is a *résumé* of what is known of the Geology of the district, in which the British Association was meeting. It is from the writings of the officers of the Geological Survey, and brings forward nothing new.

326. Goodchild, J. G.—An Outline of the Geological History of Swaledale.

"The Naturalist," p. 243.

The Pennine fault occurred at the close of the Carboniferous period. Then the Permian, which "is only the basement bed of the Jurassic System," with other New Red rocks, spread continuously over all, as did also the Cretaceous Beds. When the Swale first began to flow in Tertiary times, it carved its bed out of chalk. Then the volcanic rocks of the western islands of Scotland were formed, and upheavals took place, and thermal springs started, which, as they cooled, left the lead veins in the fissures. The cwms and terraces are due to the ice of early Glacial times flowing along the valley; at a later time the ice became part of a great field, and flowed down the slope on one side, across the valley, and then up the other slope, leaving scratches. But the valley has never been "submerged a single foot beneath the sea."

[**327.**] **Cheetham, W.**—Notes on a Tour through Durham and Cumberland.

Paper read to the Leeds Geological Association, Feb. 20, but not published in 1890.

328. Cole, E. M.—Notes on the Driffield and Market Weighton Railway.

Proc. Yorks. Geol. and Polyt. Soc., New Ser., vol. xi., p. 170.

Starting from Driffield, the cutting between 3½ and 4½ miles is in Boulder Clay with a large boulder of whin. Near Middleton, is an old beach of chalk boulders, 150—175 ft. up. The next cutting is in the Middle Chalk, the deepest, at Enthorpe, showing 100 ft. with tabular flints, all belonging to the barren zone. In the next cutting but one is the zone of *Belemnitella plena.* The last shows the *Bucklandi* and *Angulatus* beds of the Lias.

329. Davies, J. B.—Some Notes from Dingle Shore.

Trans. Liv. Geol. Assoc., vol. x., p. 30.

Gives an account of what is to be observed along the shore of the Mersey south of Liverpool docks. Several faults are shown by Slickenside surfaces, and the line of junction between the Upper and Lower Boulder Clay is very clean and straight.

330. Webb, C. F.—A Visit to Greenhill and Hawkstone Park.

Trans. Liv. Geol. Assoc., vol. x., p. 11.

A general sketch.

331. Clague, D.—Notes on Summer Rambles in the Liverpool District.

Trans. Liv. Geol. Assoc., vol. x., p. 16.

A general sketch. Notes the occurrence of Barytes in a Triassic Sandstone at Oxton, and pseudomorphs of gypsum after salt in the Boulder Clay.

[**332.**] **Woodcock, W. H.**—The Geology of Hilbre.

Paper read to the Warrington Field Club on Oct 17, but not published in 1890.

333. Gasking, S.—On the Geology of the South of the Island [of Man].

Yn Lioar Manninagh, vol. i., Back Transactions, p. 119.

A sketch, in popular style, of the points of geological interest in the South of Man.

334. Shipman, J.—The Geology of Nottingham.

Trans. Nottn. Nat. Soc. for 1889, p. 26.

The writer promises a publication on this subject, of which this paper is a general sketch. The formations exhibited are the Coal Measures, Permian, and Trias. Of the former he gives a general account, and mentions where it is exposed. The Permian is unconformable, and consists of the three lower members only. They never extended much further south than they do now, as each member is seen to die out, and the Trias rests on the Coal Measures. The Trias rocks were formed in two lake basins [he probably means marine,

since he speaks of depression producing them]; where these are seen resting on the Permian Marls they are conformable; but he considers that a considerable lapse of time took place between them, because there are higher Permian beds elsewhere. [Overlap is here taken for unconformity.]

The Lower Mottled Sandstone has a conglomerate at the base, with flakes of Carboniferous Limestone Chert, seen at Cinder Hill and Hempshill, and also at Old Radford in 1880, where ripple marks were seen on the surface of the slabs.

In the Bunter pebble beds, the slope of the false bedding is, in general, from the north-west, but another important current came from the south-west. He has found among the pebbles Caradoc Sandstone with *Phacops*, *Glyptocrinus*, and *Strophomena grandis*, and Carboniferous Limestone with *Lonsdaleia*. He accounts for the absence of the Upper Mottled Sandstone by non-deposition [and not by change of character]. The old surface of the Bunter is cut into V-shaped ruts, now filled with Keuper sediment [no locality is stated for this]. He asserts that the Hemlock Stone is composed of Keuper Basement beds, as are beds at Catstone Hill, Annesley Hill, and Blidworth [these are disputed points]. The Waterstones commence with a small conglomerate, known as Cauk; a similar conglomerate occurs at the base of the basement beds; both are cemented, and contain Permian fragments. The rock at Blidworth, he states to contain only pebbles older than the Trias [it contains *Gryphæa incurva*]. The sandstones of the Lower Keuper are marked with ripples, trending west of north. On these one footprint has been found. The Waterstones contain fishes. In the Upper Keuper Marls are pseudomorphs of salt.

[**335.**] **Lewis, G.**—Geological Sketch of the Town and District of Nottingham.

Paper read to the Chesterfield and Midland Counties Institute of Engineers.

[**336.**] **Bemrose, H.**—Notes on the Geology of Derbyshire.

Paper read to the Derbyshire Archæological and Natural History Society on April 15, but not published in 1890.

[**337.**] **Round, J.**—Geological History of Oldbury.

Paper read to the Birmingham Microscopists and Naturalists' Union, May 12, but not published in 1890.

[**338.**] **Barke, F.**—Sectional Report on Geology.

Paper read to the North Staffordshire Naturalists' Field Club and Archæological Society, March 20 (not seen, if published).

339. Thompson, Beeby.—The Bletchley Boring.

Journal Northampton Nat. Hist. Field Club (extract, no pagination).

This is a *résumé* of A. J. Jukes-Browne's paper on the subject, in the Geological Magazine, for August, 1889. The conclusion is that the rock pierced at a depth of 401 ft., which was called a granite, and considered to be a portion of the Palæozoic floor at a much higher level than elsewhere, is really a great rolled mass of microgranulite, derived from a neighbouring shore in the Callovian Sea, and possibly carried to its present position by floating wood.

340. Beasley, H. C.—A Visit to Warwick.

Journal Liv. Geol. Assoc., vol. x., p. 27.

A general sketch.

341. Spackman, F. T.—On the Fossiliferous Rocks around Worcester.

"Science Gossip," 1890, p. 243.

A general sketch of the rocks from Cambrian to Drift, with figures from well-known sources.

342. Dalton, W. H.—Notes on Geological Rambles in the Braintree District, in Connection with the Easter Excursion of the Club.

"Essex Naturalist," vol iv., p. 79.

Miscellaneous observations on drifts, and where they may be seen.

343. Holmes, T. V.—On some Sections between West Thurrock and Stafford, on the Grays and Upminster Railway.

"Essex Naturalist," vol. iv., p. 143.

Here is seen, first gravel lying on chalk, and further on, between West Thurrock and Stifford, the Thanet Sands, and other Lower Tertiaries, and the London Clay, all capped by gravel. This latter contains lumps of chalk—not requiring the agency of ice, and even if brought by ice, by not more than that of a modern severe winter. There is no sign here of the continuance eastward of the Plumstead and Erith fault.

[**344.**] **Leighton, T.**—Some Problems Relating to the Geology of the South of England.

Paper read to the South London Microscopical and Natural History Club, Nov. 18, but not published in 1890.

345. Morgan, C. Lloyd.—The Brislington Cutting.

Proc. Bristol Nat. Soc., New Ser., vol. vi., pt. ii., p. 165.

Gives a section of this cutting between Bath and Bristol. The west end is Trias, the east is Pennant Grit, overlaid unconformably. The base of the Trias much resembles the underlying rock, but is reduced by hydrochloric acid to 57½ per cent. of a red sandy residue.

346. Morgan, C. Lloyd.—Mendip Notes.

Proc. Bristol Nat. Soc., New Ser., vol. vi., pt. ii., p. 169.

At Emborrow, near Lechmere Water, beds coloured by the Survey as Lower Transition Beds, Old Red Sandstone, and Coal Measures, are Millstone Grit. The latter and Mountain Limestone are all that are present. At Ebbor Millstone Grit of various types has been mistaken for Old Red and Lower Limestone Shales. These identifications are partly stratigraphical, partly lithological, and the proper fossils of the Transition beds have not been found. At Dursdon, near Wookey, the Dolomitic Conglomerate is now worked for iron ore and manganiferous iron ore. He thinks the "Old Red Sandstone," 1 mile south-east of Cheddar is also Millstone Grit. The thickness of the Lower Carboniferous series in the Mendip area can be ascertained in Barrington Combe, of which he gives a map and section. It is

Upper or Lithostrotion Limestone	700 feet.
Gully Oolite	250 ,,
Lower or Encrinital Limestone	1,300 ,,
Lower Transition Beds	350 ,,
	2,600 ,,

[**347.**] **Ussher, W. A. E.**—On the Geology of the Neighbourhood of Castle Cary and the Coal Question of Somerset.

Paper read to the Somersetshire Archæological and Natural History Society, but not published in 1890.

[**348.**] **Goodman, C. H.**—On the Fossils and Geology of the Swanage District.

Paper read to the Croydon Microscopical and Natural History Club on Sept. 2, but not published in 1890.

349. George, J. E.—Geology and Scenery of the Isle of Wight.

Journal Liv. Geol. Assoc., vol. x., p. 13.

A general sketch.

350. Stephens, F. J.—The Perranzabuloe Mining District.

Rept. Roy. Cornwall Polyt. Soc. for 1889, p. 105.

A prize essay. This district is by the sea, and the coastline has considerably altered. There are three distinct groups of lodes. The south-underlying lodes contain copper, the north-underlying lodes contain tin, and the north and south lodes, of which the great Perran lode is one, contain iron and galena. Penhale lode is an exception. Several Elvan courses cross these. The "Cligga" is coarse grained, and impregnated with tin and wolfram. An account is then given of the various mines which have been opened in the district.

351. Williams, H. W.—Pembrokeshire as a Field for the Study of Geology; with a Map of the District.

Trans. Manch. Geol. Soc., vol. xx., p. 426.

This deals with the rocks from the so-called Archæan to the Silurian. It does not appear to contain any original observations, though the writer has apparently visited the district. The statements are taken from published works. The value of the *résumé* may be perceived from the following quotations :—1. (With reference to the controversy on the age of the beds at St. Davids, below the Cambrian Conglomerate.) "Dr. Hicks, having produced specimens of a basal conglomerate, containing fragments of the Dimetian, and also showed that the Arvonian rocks were almost entirely built up of materials which could only have come from the Dimetian." "Dr. Geikie, after this, abandoned the field to his victorious opponent, and the question has not been re-opened. [! Geological literature does not appear to reach Manchester very quickly.] 2. "The non-existence of Caradoc rocks to the east of the Longmynds tends," &c.

[**352.**] **Somervail, A.**—Geological Notes on the Channel Islands.

Paper read to the Torquay Natural History Society on Sept. 10, but not published in 1890.

[**353.**] **White, L.**—Notes from Lewis, with Chips of the Rocks.

Paper read to the Geological Society of Glasgow, Oct. 9, but not published in 1890.

354. Barclay, R.—The Geology of the Islands from Mount Battock, Kincardineshire, to the Village of Edzell, and thence to the Sea at St. Cyrus.

Proc. E. of Scotland Union of Nat. Societies, 1890, p. 19. A general outline.

[**355.**] **Coates, H., and Macnair, P.**—The Geological and Geographical Evolution of Perthshire.

Paper read to the Perthshire Nat. Science Soc. in May. Not seen.

356. Howden, J. C.—Geology of Montrose District.

Proc. East of Scotland Union of Naturalist Societies, 1890, p. 10.

The ice scratches run from west to east. On the Garvock Hills, the N.W. aspect is bare and polished, while the S.E. is covered by a bed of boulder clay often 50 ft. thick. The large boulders first dropped, were afterwards scratched as they lay, for they have striæ on their upper surfaces in the same direction as on the solid rock. A fine example was seen at Sunnyside, on a basalt boulder, in 1884. Many scratched boulders are also trawled at sea. The inter-glacial (?) clays with arctic shells and bones, contain, also, iceworn stones, as chalk, flint, pyrites, coal, and shale; they were doubtless dropped by icebergs. The ridge on which Montrose is built is formed of the boulders washed down by

Post-glacial streams. After this a warmer period set in, when peat grew, and then followed a depression, producing the *Scrobicularia* silt.

357. Dow, R.—A Geological Sketch of East Fife.

Trans. of Perthshire Soc. of Nat. Sc., vol. i., p. 139.

A very brief and general notice of the geology of the district.

358. Lindsay, Jas.—Notes on the Geology of Ayrshire.

Glasgow, 8vo, pp. 31.

A general sketch of the formations of the county, containing apparently only statements already published.

[**359.**] **McLennan, J. S.**—The Geology of Kyle.

Paper read to the Geological Society of Glasgow, Dec. 11, but not published in 1890.

PALÆONTOLOGY.

HUMAN IMPLEMENTS.

360. Anon.—Probable find of Palæolithic Flint Implements in Marlborough Forest.

Report Marlborough Coll. Nat. Hist. Soc., No. 38, p. 103.

Five of these are enumerated from the Red Vein gravel pits. There are also two Plates of figures of Neolithic flints from Aldbourne, some of which are very rough.

361. Stopes, H.—Indications of Retrogression in Prehistoric Civilization in the Thames Valley.

Paper read to the British Association, Sept. 8, and separately printed in Leeds; with three Plates.

A number (74) of flint implements have been found in the Thames Valley between Oxford and Reading, which have first been polished and then rudely chipped. Thirteen of them are figured. The conclusion is that a race of comparatively high civilization inhabited the valley and used polished tools, but they were overcome and replaced by a ruder tribe, who could not use their implements, but were obliged to shape them to the rough type they were in the habit of using.

[**362.**] **Brown, J. A.**—Early Man in the Thames Valley.

Paper read to the Maidenhead Naturalists' Field Club on Feb. 24.

363. Brown, J. W.—Flints from West Craig, Andreas.

Yn Lioar, Manninagh, vol. i., p. 174.

These were found in considerable abundance in a field behind St. Jude's Church. They consist of Cores, Chips, Flakes, Scrapers, and a few Drills. Some of the last have three points. The writer thinks they were made on the spot as wanted in the neighbourhood. There are no arrows or polished implements.

364. Kermode, P. M. C.—Flints from the Brooghs, North Ramsey.

Yn Lioar, Manninagh, vol. i., p. 131.

The flints are found in white sand at the base of a soft red sand, which seems to be a true Neolithic floor. These consist of Cores, Chips, Flakes, Scrapers, Drills, &c. They are made from chalk and flint boulders, which are scattered over the surface in the north of the island, and which probably came from Antrim. Among these are numerous peculiarly-pointed instruments, intended probably for boring or drilling holes; those that have two points with a concave curve between may have been used for scraping arrow shafts. Some are burnt, and there is also a cinerary urn.

365 Swinnerton, F.—The Early Neolithic Cists and Refuse Heap at [Alfred Pier] Port St. Mary.

Yn Lioar, Manninagh, vol. i., p. 137.

The Flint earth is a red clay, and contains flint workshop refuse. Some have semicircular concave edges as if used for scraping shafts. There are also curious long triangular flints, one side being worn away by scraping, the other preserving its sharp natural edge. Burials have taken place in this earth at a later period.

366. Brushfield, T. N.—Description of a Perforated Stone Implement found in the Parish of Withycombe, Raleigh.

Trans. Dev. Assoc., vol. xxii., p. 208, with a Plate.

Found on Woodbury Common. It is $5\frac{3}{4}$ by $3\frac{3}{4}$ in. It has a circular perforation, is rounded at one end and pointed at the other. It is made of olivine basalt.

367. Anon.—Some Figures of Flint Implements from Gloucestershire are given in pl. i.—iv. of Cotteswold Nat. Field Club, vol. x., pt. i., from Dr. Royce's collection.

[**368.**] **Rudler, F. W.**—The Present Aspect of the Jade Question.

Paper read to the British Association on Sept. 5, but not published in 1890.

369. Hughes, T. Mc.—On Cuts on Bone as Evidence of Man's Existence in Remote Ages.

Trans. Vict. Inst., vol. xxiii., p. 209.

The writer exhibited two large bones (one of which is figured by a photograph) which are scored with parallel marks, some crossing the others. These bones are Saurian bones, found 17 ft. down in the Kimmeridge Clay at Ely, and the striæ are covered by oysters. Yet they resemble the scratched bones referred to the work of man in the "Reliquiæ Aquitanicæ." [They do not look particularly like human cuts, being quite straight and symmetrical in cross section.] They are rather grooves, and it is suggested they may have been cut by sharks.

[**370.**] **Evans, J.**—Address to the Anthropological Section of the British Association: "On the Antiquity of the Earliest Objects of Human Handiwork."

Delivered on Sept. 4, but not published in the Transactions in 1890.

MIXED VERTEBRATA.

371. Woodward, A. S., and Sherborn, C. D.—A Catalogue of British Fossil Vertebrata.

Dulau, London. 8vo. Pp. xxxv., and 396.

In the Introduction is given a list of the dates of the different parts of plates, and names in Agassiz's Poissons Fossiles, and in Owen's Odontography. And then a table is given "showing the stratigraphical distribution of the genera of British Fossil Vertebrata," some of the occurrences being not previously published (these are marked *). From this table we learn the number of species in the several formations as follows:—

Upper Silurian, 8 Fishes.
Lower Old Red Sandstone Passage Beds, 3 Fishes.
Lower Old Red Sandstone, 29 Fishes.
Upper Old Red Sandstone, 12 Fishes.
Devonian, 2 Fishes.
Lower Carboniferous, 90 Fishes, 3 Amphibians.
Upper Carboniferous, 31 Fishes, 14 Amphibians.
Permian, 10 Fishes, 2 Amphibians, 1 Reptile (Protorosaurus).
Trias, 6 Fishes, 5 Amphibians, 9 Reptiles.
Rhætic, 11 Fishes, including *Semionotus*,* 1 Amphibian (Metopias), 6 Reptiles, and 1 Mammal (Microlestes).
Lias, 31 Fishes, 11 Reptiles.
Oolites, 35 Fishes, 30 Reptiles, 5 Mammals.
Purbeck, 16 Fishes, including *Mesodon*,* 17 Reptiles, 10 Mammals.
Wealden, 5 Fishes, 29 Reptiles, and one doubtful Bird (Ornithodesmus).
Potton Bone Bed, 4 Fishes, including *Asteracanthus** and *Hybodus*,* 6 Reptiles.
Lower Greensand, 4 Fishes, 4 Reptiles.
Cambridge Greensand, 9 Fishes, 20 Reptiles, 1 Bird (Enaliornis).
Gault and Upper Greensand, 17 Fishes, 6 Reptiles.
Chalk 51 Fishes, 15 Reptiles.
Eocene, 35 Fishes, 22 Reptiles, 8 Birds, 26 Mammals
Lower Miocene, 1 Fish, 1 Reptile, 1 Mammal.

Pliocene, 16 Fishes, including *Chrysophrys*,* *Cœlorhynchus*,* *Pristis*,* 2 Birds, 42 Mammals.
Forest Bed Series, 14 Fishes, 3 Amphibians, 3 Reptiles, 6 Birds, and 36 Mammals.
Pleistocene, 1 Fish, 1 Reptile, 7 Birds, 40 Mammals.
Prehistoric and Historic, 6 Birds, 22 Mammals.
Caves, 14 Birds, 36 Mammals.

In the catalogue proper, the Fishes occupy 198 pages, comprising 847 named species; the Amphibians occupy 10 pages with 34 species; the Reptiles, 92 pages with 326 species; the Birds, 10 pages with 37 species; and the Mammals, 82 pages with 241 species. There appears to be a complete series of references to all the places where any vertebrate remains are described, recorded, or catalogued, and each is referred to its appropriate species—a vast number of synonyms being given.

372. Wilson, E.—Fossil Types in the Bristol Museum.
Geol. Mag., Dec. 3, vol. vii., pp. 363—411.

A list, with details of locality and place of description, of the type fossils described by various authors, and now in the Bristol Museum. The vertebrate types are 65 in number. There are also 14 specimens which have been figured or described under names already in use.

373. Woodward, A. S.—The Application of the Laws of Comparative Osteology to the Palæontology of the Vertebrata.
Proc. Leeds Geol. Assoc., p. 27.

The general principles taught by Cuvier have now to be modified, as the bones of extinct animals cannot always be interpreted by reference to those of living creatures. The latter are only the last products of evolution; the more general laws must be deduced from more primitive and generalised types. Specialization, as in the Frog and the Duck Mole, is not to be looked for in early creatures.

374. Woodward, H.—A Guide to the Exhibition Galleries of the Department of Geology and Palæontology in the British Museum (Natural History).
Part I.: Mammals and Birds, with 119 Illustrations.

This is practically an illustrated Manual of the Palæontology of Mammals and Birds, giving a general account of the remains of these groups of animals. All the most interesting points are illustrated by figures, which represent not only the actual specimens in the collection, but what is known elsewhere about the animals which are in any way represented in it. The following animals are shown as complete skeletons or restorations:—*Megatherium Americanum*, *Mastodon Americanus*, *Mastodon angustidens*, *Elephas primogenius*, *Tinoceras ingens*, *Phenacodus primævus*, *Brontops robustus*, *Palæotherium*, *Cervus megaceros*, *Rhytina gigas*, *Scelidotherium leptocephalum*, *Glyptodon clavipes*, *Hesperornis regalis*, *Ichthyornis victor*, and *Dinornis elephantopus*.

375. Woodward, H.—A Guide to the Exhibition Galleries of the Department of Geology and Palæontology in the British Museum (Natural History).

Part II.: Fossil Reptiles, Fishes, and Invertebrates; with 94 Illustrations.

This continues for the Reptiles the same instructive method as is followed in Part I., by which the classification, peculiar features, and relations of all the most interesting Reptiles are summarized. The whole of the illustrations are connected with this class. The following animals are restored or represented by complete skeletons:—*Rhamphorhynchus Münsteri*, *Pterodactylus spectabilis*, *Dimorphodon macronyx*, *Brontosaurus excelsus*, *Megalosaurus Bucklandi*, *Scelidosaurus Harrisoni*, *Iguanodon bernissartiensis*, *Ichthyosaurus*, *Plesiosaurus*, *Lariosaurus balsami*, and *Megalobatrachus Scheuchzeri*.

The Fishes are dismissed in three and a half pages, without illustrations, and with the merest outline enumeration of names. The Invertebrates are referred to only in classes, the general characters of each class being given; and the Plants are briefly noted. A list of the Historical and Type collections is then given. They are the Hans Sloane, Brander, William Smith, Sowerby's Mineral Conchology, Konig's Icones, Gilbertson, London Clay Club, Searles Wood's Crag Mollusca, F. E. Edward's Eocene Mollusca, and Davidson's Brachiopoda.

MAMMALS.

[**376.**] **Woodward, A. S.**—Notes on the Occurrence of the Saiga Antelope in the Pleistocene Deposits of the Thames Valley.

Paper read to the Zoological Society, Nov. 4, but not published in 1890.

377. Newton, E. T.—On the Occurrence of Lemmings and other Rodents in the Brick Earth of the Thames Valley.

Geol. Mag., Dec. 3, vol. vii., p. 452.

He describes and figures the patterns of some cheek teeth in the collections of Messrs. Spurrel and Cheadle. They are referable to *Microtus* [*Arvicola*] *ratticeps*, a northern form; *Myodes torquatus*, which has a circumpolar distribution and is rare in Greenland; and *Myodes lemmus*, the common lemming of Scandinavia. [The attempt to revive such an obscure and antiquated name as *Microtus* in place of the familiar *Arvicola*, shows the necessity for an addition to the rules of nomenclature, viz., that no name universally used for a certain determinate length of time shall be displaced on account of priority alone.]

378. Newton, E. T.—On some New Mammals from the Red and Norwich Crags.

Q.J.G.S., vol. xlvi., p. 444, plate 18.

These are miscellaneous specimens belonging to the following—1. *Lutra dubia*, Blainville. It is a lower jaw from the Red Crag, Woodbridge, differing from the corresponding part of *L. vulgaris* by the size and proportions of the teeth, and in having a large hind fang to the premolar, and in these respects agreeing with *L. dubia*, a Miocene species. 2. *L. Reevei* (sp. nov.) a small carnassial germ tooth, 10 lines by 5 lines, with low cusps, quite different in appearance from the last, and only possibly Lutrine; it is from the Norwich Crag, Bramerton. 3. *Phoca Moori* (sp. nov.) This is a left humerus of characteristic shape, smaller and more slender than *P. vitulinoides* and probably a new species; from the Red Crag, Woodbridge. 4. *Phocanella minor*, Van Beneden, the distal end of a humerus from the same locality. 5. *Trogontherium minus* (sp. nov.), a right maxilla with three teeth with characteristic enamel folds, but smaller than *T. Cuvieri* and not the young, as one tooth is beginning to form fangs. 6. *Mesoplodon floris* (sp. nov.), a Ziphioid rostrum already named *M. Floweri*, but not described. It has the anterior part of the upper surface flattened, and is long and slender. The mesethmoid appears on the upper surface, pointed in front and grooved behind, and with a channel on either side uniting in front to a median groove. 7. *Mesoplodon scaphoides* (sp. nov.), a very short and deep form of rostrum, 5 inches long by 3 inches at the base. The under side curves in front like the prow of a boat. There are two apertures posteriorly on the top, and these lead to three canals seen on the side, one pair grooving the superior aspect. The mesethmoid is completely ossified, but all the sutures are obliterated. 8. *Ailurus anglicus*, Dawkins, a left upper molar agreeing with that of *A. fulgens* in having 4 larger inner cusps with a cingulum of smaller ones similarly arranged but agreeing better in size with *A. anglicus*, known as yet only by its lower carnassial.

[**379.**] **Young, J.**—Notes on Creswell Crags. Bones recently given to the Hunterian Museum.

Paper read to the Geological Society of Glasgow on March 13, but not published in 1890.

380. Flower, W. H.—The Evolution of the Horse.

Journal Royal Agricultural Society, p. 110.

A general exposition of the well-known evolution of the horse, from *Phenacodus*, *Hyracotherium*, *Anchitherium*, *Hipparion*, &c. He comments also on the hypsidont form of the horse's molars, as contrasted with the brachydont form of those of *Anchitherium*.

[**381.**] **Flower, W. H.**—The Natural History of the Horse and of its Extinct and Existing Allies.

A lecture before the Royal Institution. Not published in 1890.

382. Broom, R.—On the Fate of the Quadrate in Mammals.

Ann. Nat. Hist., Ser. vi., vol. vi., p. 409.

This bone the author cannot think to be an auditory ossicle, nor the zygomatical portion of the squamosal, nor the tympanic bone, but to have developed in a different line from the "short flattened bone, with a ball-like articular surface," seen in the amphibia-like *Parieasaurus*. In the reptiles it becomes the quadrate, and in the mammals the interarticular cartilage. That it is neither squamosal or tympanic, is seen from a monstrosity in which these are well developed, but the lower jaw is absent.

BIRDS.

383. Brodie, P. B.—On Fossil and Recent [ly ?] Extinct Birds, with an account of the Formations in which they occur, and the circumstances of their Preservation.

Proc. Warwickshire Nat. and Archæol. Field Club for 1890.

A brief sketch of our present knowledge on this subject, "the facts herein stated" being "already published."

REPTILES.

384. Colenutt, G. W.—The Fossil Chelonians of the Oligocene Strata of the Isle of Wight.

Proc. Hampsh. Field Club, p. 57, with a plate.

Remains of Chelonians are found in the Hamstead beds. He has also fine cervical vertebræ of *Trionyx* in the Osborne beds of Chapcorner Copse, but the best come from the narrow zone of *Melania turritissima* in Thorness Bay. In this zone he has found portions of the cranium and cervical vertebræ too shattered to remove satisfactorily, and later a perfect carapace (figured), 14 in. by 12½ in., two thoracic plates, scapular arch, femur, tibia, and small bones of the feet. This he refers to *Trionyx incrassata*. Mr. H. Loe, of Brading, has found two carapaces with plastra in a talus 30 ft. above the Bembridge Limestone in Whitecliffe Bay.

385. Lydekker, R.—Contributions to our knowledge of the Dinosaurs of the Wealden and the Sauropterygians of the Purbeck and Oxford Clays.

Q.J.G.S., vol. xlvi., p. 36.

This consists of 4 parts. 1. The Iguanodonts of the Wadhurst Clay. These are three in number. Two have been already described *I. Dawsoni* and *I. Fittoni;* they are determined from their ilia, of which sketches are given, as also of the ilia of *I. Mantelli, I. bernissartiensis,* for comparison. Some other bones of *I. Fittoni* (?), found 50 yards away, are referred to the same individual, because they are from the same bed. These same bones had previously (Q.J.G.S., vol. xliv.) been referred to *I. Dawsoni,* which occurs in clay 3 ft. lower down. It appears that the ilium alone is more like that of *Camptosaurus,* but the other bones are more Iguanodontiform. The third species, *I. hollingtonensis,* is new. The type is a series of bones from the same quarry, entered previously under *I. bernissartiensis* in the writer's "Catalogue of Fossil Reptilia." The femur of this new species is now figured, and its inner trochanter is said to be of the "pendent" type, while that of *I. bernissartiensis* is of the "crested" type, though the position on the femur agrees in the two species. There is also an ilium and sacral vertebræ in the quarry differing from those of *I. Dawsoni,* which probably belong to this species, and, if so, it differs from *I. Fittoni.* This species also resembles *Camptosaurus* in its pendent trochanter, but is called *Iguanodon,* because one phalangeal bone of the pollex is a conical spine. Associated bones of *I. Fittoni* have now been found in the same zone near Hastings, and these show that the inner trochanter of the femur was of the "crested" type. The author also figures a vertebra from a nodule at Hastings, which he regards as cervical, but cannot definitely locate to any species.

2. Metatarsus of *Megalosaurus,* from the Wadhurst Clay.—In the "Catalogue of Fossil Reptilia," the author had referred every Wealden Megalosaurian bone or tooth to *M. Dunkeri,* which had been named from a tooth in Germany; in particular, a metatarsal, called the left fourth, and considered to agree with one figured by Owen as of *Hylæosaurus.* Now, however, another metatarsal is found 180 yards to the east, in the same quarry, and the author can make no question that it belongs to the same individual [!], but this is smaller than the former, and reverses everything, the bone that was fourth must now be second, and Owen's bones must belong to the right foot, instead of the left [!], and there must be two species, one of which is called *Megalosaurus Oweni.* [From this it would appear that there is nothing in the bones themselves to show which is second and which is fourth, or which is right and which is left; it is a matter of size only. Are all the Megalosaurs of the Wealden always full grown ?]

3. *Cimoliosaurus Portlandicus* from the Purbeck.—This is represented by two vertebral centra, called "cervical" in the

text, but "dorsal" in the description of the figure. It is said to agree with the cervical figured by Phillips as *Plesiosaurus carinatus*. The only other Sauropterygian remain from the Purbecks is a "humerus or femur," which the author previously referred to a Wealden species, but now says "may equally well belong to the present form." On the strength of this [!] he says that, while the freshwater Reptilia of the Purbecks are allied to those of the Wealden, the marine are equally allied to the Portlandian.

4. A Pliosaurian skeleton from the Oxford Clay of Peterborough.—This refers to a series of associated bones from Mr. Leeds' collection. In the great length of the mandibular symphysis, and in the characters of the teeth, a magnificent specimen of which is figured, this agrees with *P. ferox*, which is the same as Prof. Seeley's *P. pachyderus*, a name the author does not accept. It also agrees with *P. ferox* in the characters of the cervicals, one of which is also figured. These, however, differ from those of *Pliosaurus Evansi*, which latter agree with those of *Peloneustes philarchus*, and it is, therefore, concluded that *P. Evansi* should be referred to *Peloneustes*, which differs also in the length of the mandibular symphysis.

386. Lydekker, R.—On Remains of Small Sauropodous Dinosaurs from the Wealden.

Q.J.G.S., vol. xlvi., p. 182. Pl. ix.

Some teeth (here figured) have been already referred in the Geol. Mag. to the Sauropodous Dinosaurs, called by Prof. Marsh *Pleurocoelus*, under the name *P. valdensis*, and with them an (opisthocœlous) centrum from another locality, with a lateral cavity having a shelving upper side. This specimen (figured) has no anterior ball preserved, nor neural spine. Another specimen (figured) from the Isle of Wight, is now referred to the same; it has very little of the centrum, neither the first great cavity nor anterior ball are preserved, only the upper sloping part of the lateral cavity; the principal part is the neural arch. These belong to a small animal, the dorsal vertebræ being less than 2 in. long. These are regarded as "absolutely conclusive evidence" of "a diminutive Sauropodous Dinosaur."

387. Lydekker, R.—On a Peculiar Horn-like Dinosaurian Bone from the Wealden.

Q.J.G.S., vol. xlvi., p. 185.

This is a cone-like bone, 5½ in. in height by 4 in. in base, backwardly curved, with rugged surface and irregular ridges. The base is hollowed, and has a smooth and mammillated surface like the inside of a horn core. He suggests that it *may* have been the horn core of an animal like *Ceratops*. It is from the Wealden of the Isle of Wight.

[**388.**] **Lydekker, R.**—On Certain Ornithosaurian and Dinosaurian Remains.

Paper read to the Geological Society on Dec. 17, but not published in 1890. Abstract sent to Fellows.

389. Lydekker, R.—On a Crocodilian Jaw from the Oxford Clay of Peterborough.

Q.J.G.S., vol. xlvi., p. 284, with wood-cuts.

This concerns the symphysial portion of a lower jaw, showing the splenial forming one-half the symphysis. The jaw is broad and flat, and rough below. It has 12 alveolar cavities on one side, and 13 on the other, *and these have no interval between them*. The symphysis is 8 inches long. This differs from *Steneosaurus*, *Teleidosaurus*, and *Metriorhynchus* in the smaller number of teeth, and from most in the lack of interval after the fourth tooth. It agrees in these characters with *Machimosaurus*, but a second specimen (not figured) shows the same kind of jaw, though laterally compressed, but the cranium being preserved in this, it is seen not to agree so much with the latter genus as with *Metriorhynchus*, though differing from it in its broader muzzle and shorter nasal bones. The tooth, also, is flattened and smoothed, like those of *Geosaurus* with the fore and aft crenations, and not circular in section. It is thus distinct, and he calls it *Suchodus durobrivensis*.

390. Mansel-Pleydell, J. C.—Memoir upon a New Ichthyopterygian from the Kimmeridge Clay of Gillingham, Dorset, *Ophthalmosaurus Pleydelli*.

Proc. Dorset Nat. Hist. Soc., vol. xi., p. 7.

The actual account of the remains here referred to is by **R. Lydekker.** They consist of two propodial bones, and three vertebral centra. One of the propodials is a left humerus, with three end facets, indicating its genus to be *Ophthalmosaurus*. The smaller one, with two facets, he takes to be also a humerus (right), and, therefore, to belong to *Ichthyosaurus*. As compared with the humerus of *O. icenicus*, the former is shorter, and has a larger post-axial facet. The vertebræ have a ventral groove. The only species to which this might be referred, is *I. dilatatus*, which is imperfectly defined. He therefore calls it *O. Pleydelli*.

[**391.**] **Seeley, H. G.**—On the Neural Arch of the Vertebræ in Ichthyosauria.

Paper read to the British Association, on Sept. 5, but not published in 1890.

392. Lydekker, R.—On Ornithosaurian Remains from the Oxford Clay of Huntingdonshire.

Q.J.G.S., vol. xlvi., p. 429.

The remains consist of: 1. An innominate bone, composed of an ischium, connected with the hinder portion of

the ilium to form a large expanded plate, with four flattened processes, which are the ends of ribs by which it was attached to the sacrum—a type of pelvis characteristic of *Rhamphorhynchus*. 2. Two consecutive cervical vertebræ, the base of which shows on each side an articular process for a rib. 3. A dorsal vertebra without any rib facet, with a low, long spine, opisthocœlous centrum and obliterated neuro-central suture. 4. A sacral vertebra, with the remains of widely expanded anchylosed ribs. 5. A femur, with a globular head, set obliquely on a long neck, without an inner trochanter, but with a *linea aspera* and a hollow shaft. These characters are very similar to those of *R. Gemmingii*, Zittel, from the Lithographic slate, but as the remains are from an horizon in which no pterodactyl has as yet been obtained, he calls it *R. Jessoni* (spec. nov.).

393. Barkas, T. P.—Notes on the Numerous Newly Discovered Fossil Footprints on the Lower Carboniferous Sandstones of Northumberland near Otterburn.

Rep. Brit. Ass. for 1889, p. 565.

These are 4, 3, and 2-toed, and occur in abundance at a height of 900 ft.

394. Lydekker, R.—Catalogue of the Fossil Reptilia and Amphibia in the British Museum (Natural History), pt. iv., 8vo.

The following is a list of the species under which the remains are catalogued. s. = skull or teeth; v. = vertebra; b. = any other bones:

PLACODONTIA.—*Placodus gigas*, Ag., syn. *P. pachygnathus*, Ow.; *P. bathygnathus*, Ow., s.; *P. Andriani*, Münst., syn. *P. bombideus*, Ow., s.; *Cyamodus rostratus*, Münst., s.; *C. laticeps*, Owen, s., fig.

ANOMODONTIA. PROCOLOPHONIA.—*Procolophon trigoniceps*, Owen, syn. *P. Griersoni*, Seeley, s.; *P. minor*, Owen, s.; *P. laticeps*, Seeley, s. DICYNODONTIA.—*Dicynodon lacerticeps*, Owen, s.; *D. leoniceps*, Owen, syn. *D. recurvidens*, Ow., s., fig.; *D. feliceps*, Owen, s.b.; *D. pardiceps*, Owen, syn. *D. dubius*, Ow., s.; *D. rectidens*, Owen, s.b.; *D. curvatus*, Owen, s.; *D. testudiceps*, Ow., s.; *D. tigriceps*, Ow., syn. *D. Baini*, Ow., s.; *D. parvidens*, Ow., s.; *Oudenodon* (spelt *Udenodon*) *Baini*, Owen, syn. *O. brevirostris*, Ow., *O. raniceps*, Ow., s.; *O. tigriceps*, Ow., s.; *O. megalops*, Ow., s.; *O. prognathus*, Ow., syn. *O. magnus*, Ow., s.; *O. Greyi*, Ow. s.; *Ptychosiagum*, Lydekker, named in the "Manual of Palæontology," 1889. It has the cranium, so to speak, bent upon itself, with more or less strongly marked angles at the junction of the occipital with the parietofrontal plane, and of the latter with the nasal bones. *P. declive*, Ow., s., fig.; *P. laterostris*, Ow., syn. ? *P. Alfredi*, Ow., *P. depressus*, Ow., s.; *P. microtrema*, Seeley,

syn. *P. Dunni*, Seeley, s.; *P. Murrayi*, Huxley, syn. *P. verticalis*, Ow., *P. boopis*, Ow., and *Dic. Copei*, Seeley, s.; *P. orientale*, Huxley, s.b., fig.; *Cistecephalus microrhinus*, Owen, syn. *C. chelydioides*, Ow., s.; *C. leptorhinus*, Owen, s.; *C. planiceps*, Owen, syn. *C. bathygnathus*, Ow., s.; *C. arctatus*, Owen, s.; *Ptychognathus pusillus*, Ow., b.; *Cirognathus cordylus*, Seeley, s.b.; *Eurycarpus Oweni*, Seeley, b.; 70 bones not fitted to their corresponding skulls; *Platypodosaurus robustus*, Ow., b.; *Endothiodon bathystoma*, Ow., s.; *E. microps*, Ow., syn. *E. uniseries*, Ow., s. THERIODONTIA.—*Galesaurus planiceps*, Ow., syn. *Nythosaurus larvatus*, Ow., s.; *Scaloposaurus constrictus*, Owen, s.; *Cynosuchus suppostus*, Owen, s., fig.; *Cynochampsa laniaria*, Ow., s.; *Cynodraco serridens*, Owen, syn. *C. major*, Ow., s.b.; *Ælurosaurus felinus*, Owen, s., fig.; *Æ. curvimola*, Owen, s.; *Lycosaurus pardalis*, Ow., syn. *L. tigrinus*, Ow., s.; *Hyorhynchus platyceps*, Seeley, s.; *Tigrisuchus simus*, Ow., s.; *Tapinocephalus Atherstoni*, Owen, inc. *Phocosaurus megischion*, Seeley, s.v.b., fig.; *Titanosuchus ferox*, Owen, s.b.; 37 bones undetermined; *Brithopus priscus*, Kutorga, syn. *Orthopus primævus*, Kut., cast; *Deuterosaurus biarmicus*, Eichwald, tooth, fig.; *Empedias molaris*, Cope, s., fig.; *E. phaseolinus*, Cope, s.; *Diadectes sideropelicus*, Cope, s.; *Naosaurus cruciger*, Cope, v.s., fig.; *N. claviger*, Cope, v.; *Embolophorus dolloverianus*, Cope, v., fig.; *Gorgonops torvus*, Owen, s. PARIASAURIA.—*Anthodon serrarius*, Owen, s.v.; *Pariasaurus serridens*, Owen, s.; *P. bombidens*, Owen, s.v.b.; *Propappus omocratus*, Seeley, b., fig.

AMPHIBIA. — ECAUDATA. — *Oxyglossus pusillus*, Owen, s.v.b.; *Rana Meriani*, Meyer, s.v.b.; *R. Noeggerathi*, Meyer, s.v.b.; *Leptodactylus pentadactylus*, Laurenti, b.; *L. ocellatus*, Linn, b.; *Ceratophrys cornuta*, L., s.; *Bufo melanostictus*, Schneider, b.; *Latonia Seyfriedi*, Meyer; *L. gigantea*, Lartet, s.; *Palæobatrachus diluvianus*, Goldf., larvæ; *P. gigas*, Meyer, larva; *P. Meyeri*, Troschel, v.s.b.; *P. bohemicus*, Meyer, b.; *P. Luedeckei*, Wolterstorff, v.s.b. CAUDATA.—*Megalotriton Filholi*, Zittel, v.; *Heliarchon furcillatus*, Meyer, v.s.b.; *Molge Noachica*, Goldf., skel.; *Cryptobranchus Scheuchzeri*, Holl, skel., fig.; *C. Tschudii*, Meyer, skel. LABYRINTHODONTIA.—*Mastodonsaurus giganteus*, Jager, s.v.b., fig.; *M. granulosus*, Fraas; *M. Keuperinus*, Fraas; *M. indicus*, Lydekker (n. sp.), cast of a right lateral thoracic plate, fig., from Gondwanas. No characters given. *Capitosaurus nasutus*, Meyer, s.b.; *C. fronto*, Meyer, s.; *C. robustus*, Meyer, s.b., fig.; *Metoposaurus*, Lydekker, to replace *Metopias*, Meyer, which is pre-occupied; *M. diagnosticus*, Meyer, s.; *Trematosaurus Brauni*, Bunn, s.; *Anthracosaurus Russellii*, Huxley, s.v.b. (British); *Macromerium Schwartzenbergi*, Fritsch, v.s.b.; *M. Bayeri*, Fritsch, b.; *M. simplex*, Fritsch, b.; *M. scoticum*, Lydekker, s. (British); *Loxomma Allmanni*, Huxley, s.b. (British); *Eosaurus acadianus*,

Marsh, v., cast; *Tryrania trachystoma*, Fritsch, cast, fig.; *Ichthyerpeton* (spelt *-petum*) *Bradleyæ*, Huxley, s.v. (British); *Dendrerpeton* (spelt *-petum*) *pyriticum*, Fritsch, s.; *D. deprivatum*, Fritsch, v.; *D. acadianum*, Lyell and Dawson; *D. Oweni*, Dawson, v.b.; *Brachyops laticeps*, Owen, s.; *Bothriceps australis*, Huxley, s.; *B. Huxleyi*, Lyd., s.v.b., fig.; *B. major*, Owen, s.; *Micropholis granulata*, Owen, s.; *Cricotus heteroclitus*, Cope, v.; *Archegosaurus Decheni*, Goldf., s.v.b.; *Platyposaurus Stukenbergi*, Trautschold, b.; *Actinodon latirostris*, Jourdan, s.v.b.; *Cochleosaurus bohemicus*, Fritsch, cast; *Gaudrya latisoma*, Fritsch, cast; *Chelyosaurus Vranyi*, Fritsch, cast; *Sphenosaurus Sternbergi*, Fitzinger, cast; *Sparagmites lacertinus*, Fritsch, cast; *Trimerorhachis insignis*, Cope, s.v.b.; *Eryops megacephalus*, Cope, s.v.; *E. africanus*, Lyd., s.v.; *Rhytidosteus capensis*, Owen, s.; *Pholidogaster pisciformis*, Huxley, s.v. (British). MICROSAURIA (sub order).—*Urocordylus Wandesfordi*, Huxley, skel. (British); *U. scalaris*, Fritsch, cast; *Keraterpeton* (spelt *Ceraterpetum*), *galvani*, Huxley, skel.; *C. crassum*, Fritsch, cast; *Lepterpeton* (spelt *-petum*), Huxley, skel. and cast; *Limnerpeton* (*-tum*) *elegans*, Fritsch, cast; *L. laticeps*, Fritsch, cast; *L. obtusatum*, Fritsch, cast; *Hylonomus longicostatus*, Fritsch, cast; *H. Lyelli*, Dawson; *H. Wymani*, Dawson; *H. latidens*, s.; *Seeleya pusilla*, Fritsch, cast; *Ricnodon trachylepis*, Fritsch, cast; *Orthopleurosaurus* (new name for *Orthocosta*, Fritsch [no reason given for change]) *microscopicus*, Fritsch, cast; *Smilerpeton* (*-tum*) *aciedentatum*, Dawson, s.; *Hylerpeton* (*-tum*) *Dawsoni*, Owen.; *H. longidentatum*, Dawson, s.; *Microbrachis pelicani*, Fritsch, cast; *M. mollis*, Fritsch, cast; *Dolichosoma longissimum*, Fritsch, cast; *D. angustatum*, Fritsch, cast; *Ophiderpeton* (*-tum*) *Brownriggi*, Huxley, syn. *O. nanum*, Huxley, skel. (British); *O. granulosum*, Fritsch, cast; *O. pectinatum*, Fritsch, cast; *O. vicinum*, Fritsch, cast; *O. corvini*, Fritsch, cast; *O. Zieglerianum*, Fritsch, cast; *Melanerpeton* (*-tum*) *pulcherrimum*, Fritsch, cast; *Protriton Petrolii*, Gaudry, skel.; *P. salamandroides*, Fritsch, cast and skel.; *Sparodus validus*, Fritsch, cast; *S. crassidens*, cast; *Dawsonia multidens*, Lyd. (new name, instead of "polydens," Fritsch, a mongrel); *Anthracerpeton* (*-tum*) *crassosteum*, s. (British); *Lepidotosaurus Duffi*, Hancock and Howse, b. (British); *Fritschia curtidentata*, Dawson s. ICHNITES—*Chirosaurus* (= *Cheirotherium*) *Barthi*, Kaup.; *C. Stortonensis*, Morton (British); *Chelichnus Duncani*, Owen (British); *Rhynchosaurus* (British); *Saurichnites perlatus*, Fritsch MS.; *Macropterna divaricans*, Hitchcock; *Brontozoum giganteum*, Hitchcock; *B. Sillimani*, Hitchcock; *B. validum*, Hitchcock; *Anisopus gracilis*, Hitchcock; *Anomæpus intermedius*, Hitchcock; *A. gracillimus*, Hitchcock; *Grallator cuneatus*, Hitchcock; *Indentipes elegantior*; Hitchcock.

In a supplement are catalogued additional forms belong-

ing to groups in Parts I.—III. ORNITHOSAURIA.—*Scaphognathus Purdoni*, Newton, cast (British); *Rhamphorhynchus Jessoni*, spec. nov., allied to *R. Gemmingi*, the cervical vertebræ show a distinct facet on the centrum, for the articulation of a cervical rib (British) [*see* No. **392**]. CROCODILIA.—*Goniopholis minor*, Koken, v. b. (British); *Suchodus durobrivensis*, Lydekker, cast (British); *Crocodilænuus Jourdani*, Lydekker. No specific description, but it is the only species, apparently, of the genus which is characterised by the extreme complexity of the dermal skeleton, and the nearly equal-sized teeth. DINOSAURIA. — *Cardiodon rugulosus*, Owen, tooth (British); *Mososaurus brevis*, Owen (previously called *Cetiosaurus*); *Pleurocælus valdensis*, Lyd., teeth, fig. (British). Several specimens previously called *Ornithopsis* are here changed to *Pelorosaurus*, *i.e.*, *Conybearei*, *humerocristatus*, *Manseli*, and *Leedsi*. *Bothriospondylus suffosus* is not a Theropod, but a fœtal Dinosaur. *Ornithopsis Hulkei*, Seeley, and *O. eucamerotus*, Hulke, are now called *Hoplosaurus armatus*, Gervais. *Calamospondylus Foxi*, Lyd., v. (British); *Megalosaurus Oweni*, Lyd., b. (British); *Thecodontosaurus platyodon*, Riley and Stutchbury, s.v.b. (British); *Massospondylus carinatus*, Owen, cast; *M. Rawesi*, Lyd., cast; *Arctosaurus Osborni*, Adams, cast. The name *Omosaurus* pre-occupied, is superseded by *Stegosaurus*, Marsh; *Euscelesaurus Browni*, Huxley, b.; *Orinosaurus capensis*, Lyd., b.; *Syngonosaurus macrocercus*, Seeley, v. (British); *Cynodraco eumerus*, Seeley, v.b. (British); *Camptosaurus valdensis*, Lyd.; *C. Leedsi*, Lyd., b. (British), fig.; *Iguanodon Fittoni*, Lyd., v.b. (British); *Iguanodon hollingtonensis*, Lyd., v.b. (British); *Opthalmosaurus Pleydellii*, spec. nov. [*see* No. **390**], cast (British), fig. A paddle of *Ichthyosaurus intermedius*, showing integument, fig.; *Ichthyosaurus platyodon* and *I. trigonodon* are now referred to *Temnodontosaurus*, Lyd.; *Peloneustes Evansi*, Seeley, cast (British). [It will be noticed that the majority are foreign.]

AMPHIBIANS.

395. Lydekker, R.—On Two New Species of Labyrinthodonts.

Q.J.G.S., vol. lxvi., p. 289, pl. xii., fig. 1.

Only one of these is British, from the Carboniferous Limestone of Gilmerton, Edinburgh. It consists of part of a dentary bone 8 in. long, showing labyrinthic structure in the teeth, which are of various sizes in front and more equal behind. The depth of the dentary is less than in *Anthracosaurus*, and less sculptured externally than in *Loxomma*. The teeth have a cylindrical section at the base, with smooth crowns,

and distinct, but not very prominent, fore and aft carinæ; they are slightly grooved at the base, have a large pulp cavity, and bend slightly back towards the summit, characters which distinguish them from the teeth of both the above genera. They agree, however, in these respects, with *Macromerium*, figured by Fritsch from the Rothliegende, and in size with the species *M. bicolor*, but differ from the latter, on comparing a lower jaw with an upper, in their greater backward curvature, so he calls the species *M. scoticum*.

396. Embleton, D.—On the Spinal Column of *Loxomma Allmanni*, Huxley, from the Northumberland Coal-field.

Rep. Brit. Ass. for 1889, p. 580.

Two slabs are described which were obtained from the black shale of the roof of the low main seam at Newsham Colliery, near Blyth. The total length of the two is 4 ft. 7½ in. The largest contains 32 vertebræ. The first three may be cervical, but each has a small ovoid articular facet. Each of the next four has, on its left side (seen), a distinct process terminating in a concave ovoid articulating surface, a broad square neurapophysis, and pairs of zygapophyses, and there are ribs near. The next, to number 24, are similar; the next seven have a series of peculiar costal bones; each appears double, like two ribs united for a certain distance by a smooth rather concave plate, the lateral parts, in the form of ribs, are continued beyond, and each ends above with a concave articulating surface. All the rest have articular facets. The total length of the animal, when complete, is estimated at 14 ft.

397. Hornell, James.—The Hand-footed Labyrinthodont.

Journal Liverpool Geol. Assoc., vol. ix., p. 65.

He thinks they must have had a tail to swim with, as they did not jump on land, and could not do so to advantage in the water, but they made leaps at their Ganoid prey.

FISHES.

398. Traquair, R. H.—On *Phlyctænius*, a new Genus of *Coccosteidæ*.

Geol. Mag., Dec. 3, vol. vii., p. 55.

This genus is founded on a specimen from Canada. It has a more ovate cranial shield than *Coccosteus*, and differs in details. A cranial shield from Herefordshire, in the Edinburgh Museum, and others in the British Museum, are referred to it, and it is noted that this genus is associated both in England and Canada with *Cephalaspis*, whereas *Coccosteus* and *Cephalaspis* appear, at present, to be mutually exclusive. The English species, *P. anglicus*, differs from the Canadian *P.*

acadicus in having "the postero- and antero-external angles" of the cranial shield confluent, instead of divided by a shallow notch into two.

399. Traquair, R. H. (Geol. Mag., Dec. 3, vol. vii., p. 144) says that *Phlyctænius* is pre-occupied, therefore his specimen must be called *Phlyctænaspis*.

400. Traquair, R. H.—On Phlyctænaspis, a New Genus of Coccosteidæ.

Proc. Roy. Phys. Soc. Edin., 1889-90, p. 227, pl. xii.

This contains further details regarding the genus as described in the Geol. Mag. for January, which he sums up as follows—

Genus *Phlyctænaspis*, Traquair : Cranial shield more ovate than in *Coccosteus*; constituent plates anchylosed, except the ethmoidal. Median occipital elongated, pointed in front, and wedged in the posterior ends of the oblong or ovate central plates; orbital excavation, looking more anteriorly than in *Coccosteus*; course of main lateral-line groove nearly straight from the external occipital to the post orbital, where it is very acutely bent backwards. Plates of body cuirass imperfectly known.

1. *P. acadicus*, Whiteaves sp. : External angle of cranial shield divided by a shallow notch into two—the postero- and antero-external angles; surface ornamented by fine tubercles, in most specimens showing a concentric arrangement parallel to the margin of the constituent plates. Lower Devonian, Canada.

2. *P. anglicus*, Traquair: Postero- and antero-external angles confluent; surface covered by a coarse pustulation. Cornstones, Herefordshire.

Figures of the specimens are given in the Plate.

401. Traquair, R. H.—On the Structure of *Coccosteus decipiens*, Agassiz.

Ann. Nat. Hist., ser. vi., vol. v., p. 125. Pl. 10.

He recognises only two species, *C. decipiens*, Ag., and *C. minor*, Miller, the rest being synonyms. The sutures of the cranial bones are now all made out. There is an anterior and posterior ethmoidal, and a median occipital, in the middle line. The rest of the bones are paired, viz.. premaxillæ, maxillæ, jugals, præorbitals, postorbitals, marginals, centrals, and external occipitals. There are no maxillary teeth, but both vomerine and palatal teeth. The mandible has two sets of teeth, one set on the upper edge and one set on the vertical edge in front, where the symphysis should be. There are no hyoid *bones*, those so called are the ventral rami of the dermal plates. The body cuirass has one median dorsal plate, and paired anterior and posterior dorso-laterals, and postero-lateral plates. There is an interlateral plate joining the

dorsal and ventral shields, each side having a ventral part, and a forked lateral part, the two branches being connected, one to the dorsal the other to the ventral shield. The latter consists of anterior and posterior median ventral and paired anterior and posterior ventro-laterals. He traces the distribution of the lateral line grooves, and mentions a sclerotic ring. There is no trace of vertebral centra. The dorsal fin comes just behind the dorsal plate, and is composed of two sets of interspinous bones articulated end to end with each other, and with the truncated neural spines; both sets are swollen at the ends. On the hæmal side the vertebræ at first have no spines, then very long and oblique ones, nearly opposite the dorsal fin, and forming the *supposed* anal fin; beneath this in front is a peculiar <-shaped internal bone, and further back an oval plate. These are the only signs of possible pelvic limbs. There is not a trace of anything like pectoral limbs, or articular surface for them, Prof. Trautschold and Von Koenen notwithstanding.

402. Traquair, R. H.—On the Structure of *Coccosteus decipiens*, Agassiz.

Proc. Roy. Phys. Soc. Edin., 1889-90, p. 211. Plate xi.

This is practically the same paper as already noted in the Annals of Nat. Hist.

403. Traquair (Geol. Mag. Dec. 3., vol. vii., p. 235) says he is certain the tpye species of *Coccosteus*, *C. decipiens*, never had a long stout prominent external appendage like that described by Prof. Koenen as occurring in *C. Bickiensis*.

404. Woodward, A. S.—A New Theory of *Pterichthys*.

Ann. Nat. Hist., ser. vi., vol. vi., p. 314.

This discusses a theory broached by Mr. Patten, that *Pterichthys* and its allies are more nearly related to Arachinids than to the Echordata. He shows that the supposed "cervical suture" is really only a slime canal, and that the "outer semicircular sutures" are non-existent. The dorsal shield cannot be hæmal because there is a depression below for the pineal gland. Moreover, there is a vertebrate tail, the body lobe or neural portion of which is on the dorsal side.

405. Traquair, R. H.—On the Fossil Fishes found at Achanarras Quarry, Caithness.

Ann. Nat. Hist., ser. vi., vol. vi., p. 479.

This quarry is three miles south of Halkirk. The following fishes have there been found :—*Dipterus Valenciennesii*, *Mesacanthus* sp., a genus which has larger ventral spines and also intermediate spines, and cannot be placed with *Acanthodes*. *Cheiracanthus Murchisoni*, *Diplacanthus striatus*, *Rhadinacanthus longispinus*, *Pterichthys Milleri*, *Coccosteus decipiens*, *Homosteus Milleri*, *Glyptolepis paucidens*, *Osteolepis macrolepidotus*, *Diplopterus Agassizii*, *Cheirolepis Traillii*, and *Palæospondylus Gunnii*

(gen. et sp. nov.) These latter are remarkable fossils, 1 ft 1½ in. long, with a head of crushed bones, two processes project in front, and a shield-like body passes back over three or four vertebræ. The vertebral column is bony, with definite centra, possibly ring-like, with neural arch in the first two-thirds, and neural and hæmal spines in the hinder third; no signs of limb bones; affinities very doubtful.

406. Traquair, R. H.—Observations on some Fossil Fishes from the Lower Carboniferous Rocks of Eskdale, Dumfriesshire.

Ann. Nat. Hist., ser. vi., vol. vi., p 491.

These are miscellaneous notes. *Acanthodes nitidus*, Woodward, will be described by him. *Rhadinichthys elegantulus* is now separated from *R. Geikiei*, and includes *R. delicatulus* [no reasons given]. *Acrolepis furcatus* (not *Elonichthys*), *Styracopterus furcatus* (not *Holurus*), *Mesopoma* (gen. nov.) This he separates from *Canobius* because it is more Palæniscoid in the configuration of the facial bones, and cannot be put with *Rhadinichthys* on account of the slight obliquity of the suspensorium. *Mesolepis tuberculatus* (sp. nov.) The scales are ornamented externally with a sharply defined tuberculation. *M. rhombus* (sp. nov.) The scales are small and narrow, ornamented with rounded tortuous ridges. *Cheirodopsis Geikiei* has ventral fins. *Tarrasius problematicus*, the pectoral fin is rounded, with only a small basal lobe, hence it is not Dipnoan; perhaps it is Crossopterygian.

407. Ward, J.—The Geological Features of the North Staffordshire Coal-field.

Trans. N. Staff. Inst. Min. and Mech. Eng., vol. x., pl. ii.—vii.

On pp. 134—188 are contained notes on the Fish remains of the coal strata.

Sub-class ELASMOBRANCHII; Order ICHTHYOTOMI.

Pleuracanthus lævissimus, Ag. (fig.) has a funnel-like cavity at the base of the spine; *P. robustus*, Davis; *P. alatus*, Davis; *P. Wardi*, Davis; not clearly distinct from the next; *Orthacanthus cylindricus*, Ag., he cannot accept the reference of this to *Pleuracanthus*; *Diplodus gibbosus*, Ag. (fig.), the teeth are so associated with *Orthacanthus* spines that they probably belong to the same animal; *Diplodus equilateralis* (spec. nov.) (pl. ii., fig. 2). It has two diverging conical carinated larger denticles and two minute ones in the angle between them. Deep Mine Ironstone, Longton; *D. tenuis*, A. S. W. (fig.).

Order SELACHII.

Janassa linguæformis, Atthey (fig.), a tooth. *Ctenoptychius apicalis*, Ag. (fig.); associated with these teeth has been found a part of the body covered with dense shagreen. *Callopristodus pectinatus*, Ag. (fig.). *Helodus simplex*, Ag. (fig.), originally

figured from detached teeth only. The fish is 16 in. long, broadest between head and dorsal fin, tapering behind, snout blunt. The figure represents 42 associated teeth. The trunk was covered with shagreen, dorsal spine $2\frac{1}{2}$ in., half inserted, broad, both margins straight, finely ribbed, caudal fin heterocercal. *Pleuroplax* (the name *Pleurodus* being preoccupied) *Rankinei*, Ag. (fig.); *P. Attheyi*, Barkas (fig.), *Sphenacanthus (Cœlacanthus) hybodoides*, Egert. (fig.), small teeth (also figured) are found associated with the spines. These teeth have been called *Hybodopsis Wardi*. *Gyracanthus tuberculatus*, Ag. (fig.), an unsymmetrical, probably pectoral, spine. *Euctenius unilateralis*, Barkas, a small, comb-like pointed appendage.

Order Dipnoi.

Ctenodus cristatus, Ag. (fig.), palatal dental plates; *C. obliquus*, Atthey (fig.); *C. imbricatus*, Atthey; *C. ellipticus*, Atthey (fig.), probably equal *C. obliquus; C. tuberculatus*, Atthey, probably equal *C. cristatus; C. Murchisoni*, Ag., like *C. cristatus*, but with 18—20 ridges instead of 12—14.

Order Ganoidei.

Acanthodes Wardi, Egert. (fig.), a fish body, the teeth have not been found, and the teeth of *Acanthodopsis* do not belong here. *Strepsodus sauroides*, Binney (fig.), teeth and vertebræ; the latter are discs with a huge central foramen. *Rhizodopsis sauroides*, Williamson (fig.), part of the body showing pectoral fins and median jugular plates; some of the scales present traces of ganoine. *Megalichthys Hibberti*, Ag.; *M. pygmæus*, Traquair, pl. vi., figs. 7, 8, 8A; not hitherto described; founded on mandibles which, besides being smaller, are deeper than in *M. Hibberti* ($\frac{2}{7}$ against $\frac{1}{5}$ the length). *M. coccolepis*, Thomson and Young; *M. rugosus*, T. and Y. *Rhomboptychius*, sp. (fig.), a tooth, scale and vertebra. There are also cranial bones not very distinct from *Megalichthys*; the vertebra is a ring, with large side processes. *Cœlacanthus lepturus*, Ag. (fig.), a fish body. *Elonichthys Egertoni*, Ag. (fig.), a fish body; *E. semistriatus*, Traquair (fig.), scales only figured; *E. caudalis*; Traquair (fig.), scales only figured; *E. oblongus*, Traquair; *E. Aitkeni*, Traquair (fig.), scales only figured; *E. microlepidotus*, Traquair (fig.), a complete fish body. *Rhadinichthys monensis*, Egerton, scales; *R. Wardi*, Young (fig.), scales only figured; *R. macrodon*, Traquair; *R. Planti*, Traquair (fig.), small fish body. *Gonatodus Molyneuxi*, Traquair (fig.), fish body. *Cycloptychius carbonarius*, Young (fig.), fish body. *Platysomus parvulus*, Ag. (fig.), restored figure. *Mesolepis Wardi*, Young; *M. scalaris*, Young (fig.), fish body and scale. *Cheirodus granulosus*, Young (fig.), Maxilla, pterygoid, splenial, scales figured, and two restorations by Dr. Traquair.

Class AMPHIBIA; Order LABYRINTHODONTIDÆ.

Anthracosaurus Russelli, Huxley, fragments only; *Loxomma Allmanni*, Huxley (fig.), large mandibular ramus, with long teeth figured; *Pteroplax cornuta*, Hancock and Atthey; *Keraterpeton Galvani*, Huxley, small broken skeleton, unique in England; *Pholiderpeton*.

[**408.**] **Davis, J. W.**—On the Fossil Fish of the West Riding Coal-field.

Paper read to the British Association on Sept. 10, but not published in 1890.

[**409.**] **Traquair, R. H.**—On the Fishes of the Oil Shales of the Midlothian and Linlithgowshire.

Paper read to the Royal Society of Edinburgh, July 21, but not published in 1890.

[**410.**] **Traquair, R. H.**—List of the Fossil Dipnoi and Ganoidei of Fife and the Lothians.

Paper read to the Royal Society of Edinburgh, but not published in 1890.

411. Traquair, R. H.—Notice of New and Little Known Fish Remains from the Blackband Ironstone of Borough Lee, near Edinburgh.

Geol. Mag., Dec. 3, vol. vii., p. 249.

On *Ctenodus interruptus* (Barkas), he says that numerous specimens occur which show that the only constant character of the species is the compression of the denticles in a direction at right angles to that of the ridges. The other character, the smoothness of the inner half of each ridge, is variable and partially due to wear. The author then shows reasons for adopting Dr. O. Jaekel's genus *Hemictenodus* for species typified by *Ctenodus obliquus*. It is characterised by the small number of ridges on the teeth, as compared with *C. cristatus*. There is a further difference in the cranial shields, viz., in *C. obliquus* the median occipital plate is concave in front, whereas in *C. cristatus* it is pointed also. In front of this concave border in the former is a second median plate of considerable size, separating the two anterior lateral plates which come together in the latter. These differences together he regards as of generic value. He, therefore, now calls his *Ctenodus obliquus* var. *quinquecostatus*, *Hemictenodus quinquecostatus*. He also abolishes his genus *Ganopristodus*, and refers the species *G. splendeus* to *Uronemus*, not on account of any fresh facts, but because the "resemblances have impressed him so much of late." The genus is of interest as undoubtedly Dipnoan, but one whose dentition is neither ctenodont nor ceratodont.

412. Traquair, R. H.—On a new Species of *Gyracanthus*.

Ann. Nat. Hist., ser. vi., vol. vi., p. 417.

A series of spines in the "Dunnet" shale of the Burdiehouse Limestone show a difference from *G. formosus* in their small insertion and lack of lateral curvature. These spines he calls *G. rectus*.

413. Woodward, A. S.—On the tooth of a Carboniferous Dipnoan Fish, *Ctenodus interruptus*.

Rep. Yorksh. Phil. Soc. for 1889, p. 37, figured in Plate i., fig. 2.

This has been only imperfectly described by T. P. Barkas. It has 14 coronal ridges, of which the eighth and eleventh do not extend beyond the middle of the tooth. Each ridge has on its outer half a series of broad tubercles and is only laterally compressed on its inner half. It is from the Carboniferous Limestone of Gilmerton.

414. Davis, J. W.—Fossil Fish Remains from Carboniferous Shale at Cultra, co. Down, Ireland.

Proc. Yorks. Geol. and Polyt. Soc., New Ser., vol. xi., p. 332.

Amongst these fossils are two recognisable spines which agree with those of *Anodontacanthus*, Davis, in having no lateral and posterior rows of denticles, in being straight and tapering and with the internal cavity long, but they are more slender than the other species of that genus, so he calls them *A. attenuatus* (sp. nov.), but without figure. The section is round and is laterally channelled towards the apex. Plates of *Cœlacanthus* are associated with these.

415. Davis, J. W.—On *Cœlacanthus Phillipsii*, Agassiz.

Geol. Mag., Dec. 3, vol. vii., p. 159.

A description of the caudal end of a fish to which Agassiz many years ago appended the above name. The description is not easy to follow without a figure. The scales are said to be 0·100 m. in diameter, *i.e.*, nearly 4 inches, but to be smaller than others, 0·30 metres across, *i.e.*, about 1 foot, and yet a large number of scales are preserved on a nodule 0·295 m. in diameter! There is obviously some mistake here [would it have occurred if the measures had been taken in familiar inches?] According to Otto M. Reiss, this fish should be called *Rhabdoderma*, but the author cannot think this is generically different from *C. granulosus*. It occurs associated with *Goniatites*, and therefore died in the sea.

416. Davis, J. W.—On the Dentition of Pleuroplax (Pleurodon), A. S. Woodward.

Ann. Nat. Hist., ser. vi., vol. v., p. 291, pl. xiii.

The teeth of *Helodus* are pointed and narrow, those of *Pleurodus* are round and broad. In the South Staffordshire Coal-field, spines of Pleuroplax have been found associated with teeth of *Helodus*. On a recent visit to Glasgow, the author has seen in the University Museum the fore part of

a fish with *Helodus* teeth in the front of the jaw and *Pleurodus* teeth at the back. In the collection of Wm. Thompson, is a slab with six *Pleurodus* teeth associated with sixty *Helodus*. It is seen, therefore, that *H. simplex* is identical with *P. affinis*. and that the teeth which are separate in front coalesce in the hinder part of the jaw.

417. Woodward, A. S.—Notes on some Ganoid Fishes from the English Lower Lias.

Ann. Nat. Hist., ser. vi., vol. v., p. 430, pl. xvi.

This paper consists of more careful generic descriptions than have hitherto been given, and this portion cannot be summarised. The families dealt with are: 1. *Palæoniscidæ*. The only genera recognised are *Centrolepis*, *Oxygnathus* (syn. *Cosmolepis* and *Thrissonotus*), and *Coccolepis*, *i.e.*, generally identical with one from the Solenhofen Slate, except *possibly* in the articulation of the pectoral fin rays. The British species differs from the other in its remote and smaller dorsal fin, and is, therefore, called *Coccolepis liassicus*. 2. *Cœlacanthidæ*. The only genus represented is *Undina*, which is the same as *Holophagus*, but as the species differs from *H. gulo*, Huxley, by the characters of scales and fewness of caudal rays, he calls it *U. barroviensis*. It is from the Lower Lias of Barrow-on-Soar.

418. Browne, M.—Revision of a Genus of Fossil Fishes.—*Dapedius*.

Trans. Leicester Lit. and Phil. Soc., vol. ii., p. 196, with plate i.

This is the first instalment of a promised series which shall deal with the whole genus. After having given an account of the meagre literature of the subject, and shown that the dental characters of unicuspid and bicuspid teeth, supposed to distinguish this genus from *Tetragonolepis* or *Æchmodus* are unavailable, he deals with the species *dorsalis* and *monilifer*. Having set out the distinctions drawn by Agassiz, he deals with them *seriatim*. He says the extra breadth would be caused by pressure [but the length would also be increased.] The other character, of there being beads on the head scales, is present in a fish "which agrees precisely with Agassiz's figure and description" of *D. dorsalis*. He, therefore, considers the two species the same, and also *D. striolatus*, and all three are probably the young of *D. orbis*.

419. Woodward, A. S.—The Fossil Sturgeon of the Whitby Lias.

"The Naturalist," p. 101.

This is a short *résumé* of the writer's work on *Gyrosteus mirabilis*, already published in the proceedings of the Geologists' Association. It is accompanied by a restoration of *Chondrosteus accipenseroides* with the skeleton of a sturgeon by the side.

[**420.**] **Howes, G. B.**—The Pectoral Fin Skeleton and Affinities of the Liassic *Squaloraya polyspondyla.*

Part of a paper read to the Zoological Society, Dec. 2, but not published in 1890.

421. Woodward, A. S.—A Synopsis of the Fossil Fishes of the English Lower Oolites.

Proc. Geol. Assoc., vol. xi., p. 285, with plate iii.

SELACHII.—*Hybodus* teeth are represented by forms which may be classed as *H. polyprion*, rather like some early *Notidanus* teeth, *H. levis* with a stout depressed base and *H. grossiconus*, all with high crowns and well developed lateral tubercles. *Acrodus* is represented by teeth of two distinct forms, viz., *A. leiodus*, A. S. Woodw., which are very small and depressed with coarse wrinkles, and *A. leiopleurus* high crowned, with a pair of lateral bosses and numerous sharp branching wrinkles. One of the kinds of teeth called *Strophodus* belongs to *Asteracanthus ornatissimus*, the rest are ranged in three species, *S. magnus*, *S. tenuis*, which is narrower, and *S. lingualis*, smaller, narrower, and with coarse reticulations. The spines are *Asteracanthus semisulcatus*, with its tubercles running into ridges, and *A. acutus*. *Nemacanthus brevis* is a spine, possibly of the same species as the teeth called *Hybodus levis*. The "asterospondylic" vertebræ probably belong to some of the above.

CHIMÆROIDEI.—These belong to two genera: *Ischyodus* with two patches of tooth substance on the inner side of the grinding surface, one on the outer side, and one posterior, and with a slightly notched hinder border, represented by two species, *I. Colei* and *I. emarginatus*; and *Ganodus*, deeply notched behind, of which there are many forms not here distinguished. Spines possibly belonging to this genus are called *Leptacanthus semistriatus* and *L. serratus*. An undetermined Ichthyodorulite is called *Pristacanthus securis*, which is unique, and may have belonged to a Chimæroid fish.

DIPNOI.—The only Jurassic example of this order is the tooth of *Ceratodus Phillipsii* from Stonesfield Slate, and also from the Great Oolite of Northampton.

GANOIDEI.—These are most numerous generically. The scales of *Lepidotus* are all referred to *L. unguiculatus*. A mandible called *Pycnodus rudis* also probably belongs here, and a sub-operculum has been called *L. tuberculatus*. No undoubted remains of *Pholidophorus* have yet been recognised, though several fragments have been referred to it, and *P. minor* may be a *Leptolepis*. *Ophiopsis* is distinguished by its long dorsal fin, slender trunk, and pointed snout. It is represented by *O. (Pholidophorus) Flescheri*. *Macrosemius brevirostris* is a maxilla whose generic position is not well defined. The maxilla called *Pholidophorus minor* is probably the same. The mandibular

rami called *Caturus pleiodus* have no good generic characters. The fragments of *Leptolepis* may be called *L. disjectus*. The snout called *Sauropsis mordax* belongs to *Aspidorhynchus*, and a combined splenial and dentary bone, with teeth showing a gradual slope of the cranial roof and relatively large teeth, may be called *A. crassus*, to which the bone called *Belonostomus flexuosus* probably also belongs. Possible representatives of *Belonostomus*, however, occur in the Stonesfield Slate, and may be called *B. leptosteus*. Many of the teeth called *Pycnodus* and *Gyrodus* are now referred to *Mesodon*; only four species can be adequately recognised. These are: *M. Bucklandi*, founded on a tooth-bearing vomer, and of this *Pycnodus obtusus* seems to be the hinder part. The mandible, with similarly spaced teeth, called *P. didymus*, may be correlated with it, as may some scales of corresponding size called *Gyrodus perlatus*. *M. rugulosus* has closer teeth, with faint radiating striations. *P. parvus* and *P. latirostris* are mandibles probably belonging to the same, as are the vomers called *G. trigonus* and *G. oblongus*. *M. biserialis* has close set teeth, and there are only two outer series. Another species is new, and may be named *M. latidens* [called *M. tenuidens* in the plate]. It has laterally elongated principal teeth, tapering inwardly, and flanked by a single inner series, and two to four outer series of smaller teeth. A small vomer from the Great Oolite, called *Pycnodus discoides*, is not well characterised generically, but seems to belong to *Microdon*. A right mandible with Pycnodont dentition once called *Gyronchus oblongus* but relabelled *Scaphodus heteromorphus*, may temporarily be left under the latter name. Some large round scales with ragged anterior border belong to *Ctenolepis* and one has been called *C. cyclus*.

The fish remains, figured on the Plate, belong to *Nemacanthus brevis*, *Pristacanthus securis*, *Ischyodus*, sp., *Ganodus* sp., *Ceratodus Phillipsii*, a Cælacanth Ganoid, *Lepidotus unguiculatus*, *Macrosemius brevirostris*, *Caturus pleiodus*, *Aspidorhynchus crassus*, *Leptolepis disjectus*, *Mesodon Bucklandi*, *M. rugulosus*, *M. biserialis*, *M. tenuidens*, *M. ? discoides*, and *Scaphodus heteromorphus*.

422. Thompson, Beeby.—Fossil Fishes of the Lower Oolites.

Journal Northamptonshire Nat. Hist. Soc., vol. v.

This is a condensed report of A. S. Woodward's paper on the above subject in the Proceedings of the Geologists' Association, which is especially interesting to Northamptonshire geologists, from the fact that nearly all the specimens there described have been obtained from the Great Oolite of that county by Thos. Jesson.

423. Woodward, A. S.—On a Head of *Eurycormus*, from the Kimmeridge Clay of Ely.

Geol. Mag., Dec. 3, vol. vii., p. 289, pl. x.

This head is well preserved and not much compressed; its anatomical characters are here described. Associated with it are vertebræ similar to those described by Zittel under this name. The genus is seen to be very closely allied to *Amia*. The species is called *E. grandis*.

424. Woodward, A. S.—Notes on some New and Little-known British Jurassic Fishes.

Rep. Brit. Ass. for 1889, p. 585.

Printed *in extenso* in the Geol. Mag. for Oct., 1889. The species described are: 1. *Eurycormus grandis*, from the Kimmeridge Clay of Ely, differing from *E. speciosus* in the granulation of the head bones; 2. *Strobilodus suchoides*, Owen, sp., was called *Thlattodus*, but the present name is the older; 3. *Hypsocormus Leedsii* and *H. tenuirostris*, spec. nov., two jaws from the Oxford Clay of Peterborough, in the first the two great teeth in the upper jaw are markedly oblique, in the second the snout is elongated and acutely pointed, and the teeth are vertical; 4. *Leedsichthys* [*!*] *problematicus*, gen. et spec. nov., some very large head bones; 5. *Thrissops* occurs in the Kimmeridge Clay and Portland stone of Dorset. 6. *Browneichthys* [*!*] *ornatus*, gen. et spec. nov., a small elongated fish with persistent notochord and thin cycloidal scales with ganoine on their surface and on the cranial bones; dorsal and ventral ridge-scales large and pointed.

425. Woodward, A. S.—Note on the Gill-rakers of *Leedsia problematica*, a Gigantic Fish from the Oxford Clay.

Geol. Mag., Dec. 3, vol. vii., p. 292.

This is merely to describe two fragments—figured on the plate. They are said to be the most characteristic elements of a large fish. Neither are complete, the fragments being about 2 in. long. The generic name is now altered to *Leedsia*, the former one, *Leedsichthys*, being objected to. [Is *Browneichthys* to stand ?]

426. Woodward, A. S.—On some British Jurassic Fish Remains referable to the Genera *Eurycormus* and *Hypsocormus*.

Abstract in Proc. Geol. Soc., p. 8.

No information on the characters is given in the abstract. The former genus is represented by *E. grandis* from the Kimmeridge Clay of Ely, the latter by *H. tenuirostris* and *H. Leedsii* from the Oxford Clay of Peterborough. [Some details on these fishes have been given in the Geological Magazine. (*See* No. **424.**)]

427. Woodward, A. S.—On a New Species of Pycnodont Fish, *Mesodon Damoni*, from the Portland Oolite.

Geol. Mag., Dec. 3, vol. vii., p. 158.

This is founded on the specimen figured by Damon (Geology of Weymouth, 1860-88, suppl. pl. 8, fig. 9) as *Pycnodus*

Bucklandi. This is now referred to *Mesodon*, and said to differ from *M. Bucklandi*: 1. By having the inner series of teeth relatively larger; 2. By exhibiting part of the supplementary inner row; and 3. By displaying the outer small teeth in three series, with half of a fourth series all very irregularly arranged. It differs from its nearest ally, the Swiss *M. Nicoleti*: 1. By the relatively larger size of its inner teeth; 2. By the presence of a partial supplementary series inside, and of a fourth outside; 3. By the greater irregularity in the arrangement of its three rows of outer teeth.

428. Woodward, A. S.—On some New Fishes from the English Wealden and Purbeck Bed referable to the Genera *Oligopleurus*, *Strobilodus*, and *Mesodon*.

Proc. Zool. Soc. for 1890, p. 346, pl. 28, 29.

Oligopleurus vectensis, spec. nov., is represented in the British Museum by a large laterally compressed skull and mandible from the Wealden of the Isle of Wight. Some bones from the Purbeck referred to *Lepidotus minor* by Agassiz (Poiss. Foss., pl. 29, fig. 12), are also referable to this. The following bones are recognisable in the skull, and their shape is described:—The parasphenoid, hyomandibular, quadrate, metapterygoid, entopterygoid, ectopterygoid, premaxilla, maxilla, supramaxillary, articular, dentary, ceratohyal, epihyal, branchiostegal rays and preoperculum. No teeth are preserved in the Wealden specimen, but small conical ones on a right dentary are found in the Purbeck one. The supposed *Lepidotus minor* shows a branchial arch with a close series of enormous bony gill-rakers, each smooth, elongated, and tapering. The vertebræ are completely ossified, narrow, and amphicœlous. The neural spines are long and slender, fixed to low arches, and the hæmal elements are feeble. The reference of this to *Oligopleurus* depends on the form and proportions of the jaws and dentition, the character of the vertebral centra, and the slight development of the neural and hæmal arches. It appears to differ from *O. esocinus* in the narrowness and greater relative depth of the anterior vertebræ, possibly also by more slender proportions.

Strobilodus purbeckensis, spec. nov., is represented by a crushed head and pectoral arch from the Purbeck of Swanage. The cranium is narrow and elongated, with a well-developed parasphenoid; the premaxilla is short, the maxilla long; the mandibular suspensorium is very oblique; the preoperculum is long and narrow. A single series of teeth, large and well spaced, occupies the whole margin of the mouth above and below. Each tooth is fused with the bone, is tumid below, and tapers above. There are 28 or more in the upper, and 20 in the lower jaw. The pectoral fin has 15 or more stout unarticulated rays. The scales are thin and ganoid,

the vertebræ are represented by narrow and robust rings. This differs from known species in being half the size, in the relative narrowness of the maxilla and mandible, the slenderness of the points of the teeth, and the length of the hinder maxillary ones.

Mesodon Daviesi, spec. nov., is a complete fish from the Purbeck of Swanage. It is round and short (about 10 in. long), the depth being a little less than the head and trunk, and the head is $\frac{1}{5}$th of the whole, and is more than twice as deep as broad, the facial profile being vertical. The principal teeth are not more than twice as broad as long, and the rest fairly large and round. There may be only two outer series of teeth in the mandible. Notochord persistent, 13 abdominal segments, 20 caudal, pectoral fin on the side, broad and delicate dorsal fin from the middle of the trunk of 39 rays, anal $\frac{3}{4}$ as long, with 30 rays, starts behind the dorsal, but reaches the same level towards the tail, tail truncated, narrow at the base, all the rays articulated. It differs from *M. macropterus* of the Lithographic slate in the proportions.

429. Mansell-Pleydell, J. C.—*Histionotus angularis.*

Proc. Dorset N. H. and F. C., vol. xi., p. 91, with a Plate.

A very fine specimen from the Middle Purbeck at Herston, Swanage. The body is triangular above; the anterior margin of the first ray of the dorsal fin has a series of fulcral rays. The fin is continuous nearly to the tail. The pectoral, ventral, and anal fins are preserved, and the caudal fin is deeply forked, which is not the case in *Lepidotus*. The species was first described by Egerton.

430. Woodward, A. S.—On Two Groups of Teeth of the Cretaceous Selachian Fish *Ptychodus*.

Rep. Yorksh. Phil. Soc. for 1889, p. 38. Figured on Plate i., figs. 3—20.

A series of 80 teeth of *P. mammillaris* is in the York Museum, but they are disturbed. A small upper median tooth is seen to have a rather smooth crown, with only 3 short ill-defined ridges. There are also 70 associated teeth of *P. polygyrus*, the largest is a median tooth, the so-called *P. latissimus* of Agassiz, now removed to *P. polygvrus*.

[**431.**] **Woodward, A. S.**—On some Upper Cretaceous Fishes of the Family Aspidorhynchidæ.

Paper read to the Zoological Society on Nov. 18, but not published in 1890.

[**432.**] **Davis, J. W.**—Fossil Fishes of the Yorkshire Chalk.

Paper read to the Leeds Geologists' Association on Jan. 16, but not published in 1890.

433. Anon.—*Platychærops Richardsoni.*

Rep. Yorksh. Phil. Soc. for 1889, p. 35. Figured on pl. i., fig. 1.

Attention is called to the unique specimen of a jaw referred as above, and found, before 1834, in the London Clay of Herne Bay. It was suggested that it belonged to *Esthonyx*, Cope, but that author will not accept the reference. It has since been suggested that it is a creodont, but as no anterior teeth are preserved but molars only, its true relationship cannot be determined.

434. Woodward, A. S.—Evidence of a Fossil Tunny from the Coralline Crag.

Ann. Nat. Hist., ser. vi., vol. v., p. 294.

A vertebra in the British Museum collection agrees well with figures 20, 21, and another with figures 10—19 in a paper by R. Storms (Bull. Soc. Belg. Geol., &c., vol. iii., pp. 163—178, pl. vii.), On scomberoid fishes from the Scaldisian Pliocene of Antwerp, which figures are called by him *Thynnus scaldisiensis*.

435. Newton, E. T.—Note on the Occurrence of the Tunny (*Thynnus Thynnus*) in the Cromer "Forest Bed."

Geol. Mag., Dec. 3, vol. vii., p. 264.

It is represented by a large vertebra found at East Runton. This has lost all its processes, but the centrum agrees closely in all its characters with the 19th vertebra of the large Tunny in the Museum of the Royal College of Surgeons. It is 43 mm. long. by 53 mm. wide and 45 mm. high, and has a large longitudinal bar on each side, with a deep fossa above and below. The Tunny vertebra from the Crag is seen, on comparison, to be distinct.

MIXED INVERTEBRATES.

436. Howse, R.—Catalogue of the Local Fossils in the Museum of the Natural History Society [of Newcastle-on-Tyne].

Nat. Hist. Trans., Northumb., Durham, and Newcastle-on-Tyne, vol. x., pt. ii., p. 227.

With the exception of recent deposits, the highest beds that have yielded fossils are the Botryoidal limestones. From these he gives a list of 3 Plants, 5 Foraminifera, 1 Annelid, 10 Entomostraca, 6 Mollusca, and 4 Fishes. From the Shell limestone, 1 Alga, 1 Foraminifer, 4 Sponges, 2 Corals, 1 Annelid, 2 Echinoderms, 13 Entomostraca, 1 other Crustacean, 7 Polyzoan, 16 Brachiopods, 19 Lamellibranchs, 16 Gasteropods, 1 Pteropod, and 1 Cephalopod. From the Lower compact Limestone, 2 Plants, 2 Foraminifera, 3 Entomostraca, 1 Crinoid, 5 Polyzoan, 14 Brachiopods, 11 Lamelli-

branchs, 3 Gasteropods, 1 Cephalopod, 2 Fishes, and 1 Amphibian (*Lepidotosaurus Duffi*, Han. and Howse). From the Marl Slate, 9 Plants, 1 Annelid, 1 Brachiopod, 1 Lamellibranch, 1 Cephalopod, 14 Fishes, and 2 Reptiles (*Proterosaurus*).

The fossils from the Coal Measures are as follows:—Of plants there are 9 referred to Equisetaceæ, of which the synonyms are given, especially the names applied in one case to the stem, and in others to the foliage or fruits, but it is not stated which of these is represented in the collection. 22 are Ferns, 20 are Lycopodiaceæ, treated as the Equisetaceæ. [Mr. R. Kidston states that he does not agree with some of the identifications of this writer.] 5 Fungi are also recorded. 1 Annelid, 1 Crustacean, 2 Insects, 6 Mollusca, 34 Fishes, mostly from the Low Main Seam, Newsham, and 6 Amphibia. The fossils from the Carb. Limestone are—5 Plants, 1 Foraminifer, 13 Corals, 2 Echinoderms, 1 Polyzoan, 22 Brachiopods, 18 Lamellibranchs, 12 Gasteropods, 3 Heteropods, 1 Pteropod, 12 Cephalopods, 17 Fishes.

437. Wilson, E.—Fossil Types in the Bristol Museum.

Geol. Mag., Dec. 3, vol. vii., pp. 363—411.

A list, with details of locality and place of description, of the type fossils described by various authors, and now in the Bristol Museum.

The invertebrate types are 125 in number, two of which are now re-identified. There are also 35 specimens which have been figured or described under names already in use.

438. Hall, Townsend M.—On the Association of Minerals and Fossils in South Devon.

Trans. Devon. Assoc., vol. xxii., p. 166.

The writer states that the fossils of the Haldon Greensand are turned into flint. At Haggington Beach, Ilfracombe, into pure quartz. In Venn Quarry and Bickerton, North Devon, Goniatites are pyritized, but not the Lamellibranchs. In the Hangman Grits, Naticas are converted into Ferric Oxide. In the Pilton beds, at Saunton Court, Down End, into Galena.

439. Whidborne, G. F.—Monograph of the Devonian Fauna of the South of England.

Pal. Soc. Part ii. The fauna of the Limestones of Lummaton, Woolborough, Chercombe Bridge, and Chudleigh. Pp. 47—154. Pl. v., xv.

This part commences in the middle of the Entomostraca, all the species here described having been figured in the previous part. They are *Cypridella*, sp., *Polycope simplex*, Jones and Kirby, *P. devonica*, Jones, and vars. *major*; which is more elongate and subcuboidal in shape; *obliqua*, obliquely rounded at the ends; *concinna*, more orbicular and less symmetrical; *P. Hughesiæ* (sp. nov.). It resembles *P. devonica*,

but is more angulated, less uniform, and has less steep sides. *Entomis peregrina*, allied to *E. tuberosa*, Jones, but is less elongate, its knob is larger and less defined, its grooves smaller and less vertical, its posterior half less elevated, and the end narrower and less rounded. *Cyprosina Whidbornei*, Jones, which he makes the type of a new family the *Cyprosinidæ*.

The remainder of the part is occupied with Cephalopods, which are concluded in it. The species described are *Goniatites obliquus*, Whidb. Umbilicus $\frac{1}{4}$ of the diameter, sides rising perpendicularly, then flat and sloping to a flat band on the ventral area, with coarse ribs on the inner whorls only, sutures with one lateral, almost external, saddle. *G. fulguralis* (sp. nov.). Umbilicus $\frac{1}{3}$ diameter, sides steep, then convex, with a low, broad, ventral band, bordered on each side by a shallow depression, ornaments fine sigmoid striæ, curving backwards on ventral area; *G. transitorius*, Ph., *G. inconstans*, Ph., *G. molarius* (sp. nov.) = *G. excavatus*, Ph., in his Palæozoic Fossils, but not in his Geol. of Yorkshire. *G. aratus*, Whidb. Umbilicus $\frac{1}{8}$ diameter, thickness $\frac{2}{5}$, uniformly convex, except for a slight depression just beyond the umbilicus, with four suture-like sulci. *G. globosus*, Münster. It does not appear that *G. molarius* differs much from this, but is usually not so thick [the author speaks of this as the depth, and of the diameter as height, but in the usual acceptation depth = negative height]. *G. Hughesii*, Whidb., large and involute, sides gently convex from the greatest thickness near the centre. Thickness $\frac{4}{15}$ diameter. One lateral lobe a little beyond the centre of the side. The specimen shows epidermids (?) *G. circumflexifer?* Sandb. [a small involute shell, with few characters, might be almost anything]. *G. psittacinus*, Whidborne. Umbilicus very minute, closed by the shell, thickness $\frac{4}{5}$ diameter, rather flat on the sides, often elliptical [compressed?], septa approximate, sutures differently drawn in the several specimens. *G. nuciformis*, Whidb., shell involute, with minute umbilicus, thickness $\frac{2}{3}$ the diameter, sides flattened, sutures scarcely curved, except for the ventral lobe of doubtful existence; one specimen is represented with four curved sulci. *G. pentangulatus*, Whidb. Umbilicus $\frac{2}{5}$ diameter, whorls uncovered; thickness $\frac{4}{13}$ diameter, side with an angle half-way out, making a pentagonal aperture, keel simple and sharp, ornaments backward curving striæ, developing to ribs. *G. serpentinus*, Ph., not seen. *Temnocheilus inornatus*, Whidb. [As this is practically a Nautilus, the specific name is liable to confuse.] Last whorl about $\frac{2}{5}$ diameter, inner whorls uncovered, aperture transversely oval, diameters 5 : 3, thickness $\frac{2}{3}$ diameter, sutures with a forward bend at greatest thickness, septa 14 per whorl. *Trochoceras Foordianum* (sp. nov.), slightly asymmetric, last whorl $\frac{4}{11}$

diameter, scarcely involute, with 21 backward curving ribs meeting on the ventral area, and concave interspaces. *T. Vicarii*, Whidb., one whorl only, outer side nearly $\frac{1}{2}$ diameter, six times the adjacent whorl, section circular to quadrate, seven knobs in half a whorl, with obscure ribs leading to them, and longitudinal striæ. *T. pulcherrimum*, Whidb., a similar shell with ten knobs in half a whorl, and transverse striæ. *T. obliquatum*, Ph., including *C. nodosum*, Ph.; *T. reticulatum*, Ph.; *Gyroceras præclarum*, Whidb. = *Cyrt. ornatum*, Ph. [why is this not a Trochoceras, being asymmetric ?]. One figure shows a swollen spheroidal apex. *G. asymmetricum* (sp. nov.) differs from the last in having the ridges more distant and oblique, and in other inappreciable ways [a very doubtful species]. *G. ornatum*, Goldf. = *Cyrt. majesticum*, Whidb. This is now believed to be a German specimen, and is figured by mistake, but the species is said to occur at Mudstone Bay. *G. tredecimale*, Ph. [why is this not a Cyrtoceras ?], an apex is figured with a circular boundary and longitudinal ridges commencing almost immediately. *G. Eifelense*, D'Arch and Vem. New to Britain. Differs from the last in the much larger number of ribs, the greater curvature and finer marking, the siphuncle is small and near one border [which ?]. *G. Crickii* (sp. nov.), a similar form more rapidly tapering, without transverse ridges and numerous longitudinal ribs and transverse threads convex to the aperture [they are drawn concave; both these species appear to be Cyrtocerata]. *G. armatum*, Ph., includes *C. Nautiloideun*, Ph., which is a worn specimen. *G. Leei*, Whidb., imperfect, with foliaceous transverse lamellæ, and obscure longitudinal risings, differs from *G. tredecimale* by the size and irregularity of the former [but *see* pl. x., fig. vi.]. *Cyrtoceras quindecimale*, Ph.; *C. fimbriatum; C. difficile* (sp. nov.) height of arc $\frac{1}{3}$ its base, with a series of transverse frills, and signs of intermediate ones, and 20 to 30 longitudinal ribs [seems identical with *G. Eifelense*]. *C. lineatum*, Goldf. ? = *C. marginale*, Ph., septum only. *C. Robertsii*, smooth, with lines of growth only, section subcircular but distorted, height of exterior arc $\frac{1}{14}$ its base. Rate of lateral increase 4 in 9, [with no other characters, and therefore really indeterminate]: shell said to be *all* septate. *Phragmoceras ? ungulatum*, Whidb. This shows no aperture, but is slightly constricted towards the larger end. Curvature varying, height of arc $\frac{1}{7}$ to $\frac{1}{8}$ base, rate of lateral increase nearly 1 in 2, lines of growth imbricating upwards [Cyrtoceras ?]. *Poterioceras vasiforme*, Whidb. Mostly body chamber, swollen as usual, average rate of lateral increase 8 in 11, section transversely oval, ratio 4 to 5, siphuncle marginal, endo-centric, beaded. *P. Marri*, Whidb. General rate of increase about 8 in 5, septal portion straight, chambers $\frac{1}{8}$ or

more the diameter, aperture much contracted [might be Gomphoceratoid], has numerous longitudinal [? normal] lines on the cast. *P. ellipsoideum*, Ph.; *Gomphoceras poculum* (sp. nov.) section oval, ratio 6 : 5, greatest rate of increase 5 in 9, constriction, as seen near aperture, slight; siphuncle large, ventral; surface smooth [of the same genus as the last]. *Actinoceras devonicans* (sp. nov.) smooth, slow tapering, septa oblique on short diameter, section being oval, siphuncle on septum ¼ short diameter nearer the upper side. The surface shows organic deposit. *Orthoceras rapiforme*, Sandb. New to Britain; section circular; rate of increase 3 in 7, siphuncle central, septa oblique, ornaments impressed striæ. *O. eutrichum*, Whidb. Rate of increase 1 in 11, surface with longitudinal threads, with 2 or 3 between and transverse fine striæ. *O. tenuistriatum*, Münster. *O. Robertsii* (sp. nov.), section circular, rate of increase 1 in 13, septa concave, ⅛ diameter apart, with transverse irregular lines of growth, siphuncle central, ⅛ diameter of shell. *O. Vicarii*, Whidb. Section circular, rate of increase 1 in 15 increasing to 1 in 10, chambers ¼ diameter, concave, siphuncle small, nearly central; transversely arching sharp ribs, 3 per chamber, with concave interspaces, also var. *eductum*, ribs remoter, increase slight, small. *O. dolatum* (nom. nov.) = *O. hastatum*, Whidb. Section elliptic, average rate of increase 1 in 9, siphuncle central, large; has large oblique ribs equal the interspaces and confluent with them, crossed by longitudinal threads and smaller intermediate ones, the ribs dying out on the body chamber. *O. tubicinella*, Sow.; rate of increase 1 in 12, ribs rounded and well defined. *O. subtubicinella* (sp. nov.), rate of increase said to be 1 in 12, becoming nearly zero [but the specimen is figured with a rate of 1 in 9], the rays are half as close again as in *O. tubicinella*. *O. subannulare*, Münster. New as Devonian in Britain. *O. oryx* (sp. nov.) = *O. ibex* Phil. (non Sow.). *O. champernowni* (sp. nov.) = *O. imbricatum*, Phil. (non Wahl) [the flat and approximate septa and incurved body chamber seem to show this to be a Poterioceras]. *O. laterale*, Ph., in Pal. Foss. Smooth, rate of increase 1 in 7 or 8, slightly curved [since Phillips' Carboniferous *O. laterale* is a synonym of *O. undulatum*, Sow., and as Phillips wrongly identified this species with that, his name ought not to hold good, and this should therefore be called by the next name, *O. simplicissimum*, Sandb.]. *O. cf. tæaiale*, Barr, like the last, but with closer septa. *O. speciosum*, Münster = *O. cinctum*, Ph. (non Sow.). It is smooth, and one example shows the normal line. *O. cf. acuminatum*, Eichwald = *O. Ludense*, Ph. (non. Sow.). Fragments only. [Note. The short descriptions here given are not always taken from the words of the author, but are, in part, derived from his figures.]

CEPHALOPODA.

440. Buckman, S. S.—A Monograph of the Inferior Oolite Ammonites of the British Isles.

Pal. Soc., part iv., pp. 145—224, pl. xxiv.—xxxiii.

On the ground that Dr. Wright only figured one species, *Harpoceras variabilis*, he commences with the description of its allies, which he refers to the genus *Haugia*, though they all belong to the Jurensis zone of the Lias. [The meaning of species, and still more that of genera, in the Monograph, is of the most restricted kind, but their distinctions being apparently arbitrary—and often changing from one part of the Monograph to the next—it is impossible to tell what value they may ultimately have. The difficulty of making short diagnoses is that the descriptions do not always correspond to the figures, nor to the original definition of the authors quoted, but sometimes to the figures referred to other species.] With one or two exceptions, the whole of the series dealt with are from the south-west of England.

The following are the names assigned :—*Haugia variabilis*, D'Orb.; *H. jugosa*, Sow. This is the same as *A. Ogerieni*, Dumortier, who says it differs from *A. variabilis*, by more swollen whorls, the regularity and direction of its ribs, its smaller keel, and smooth inner whorls. In the latter, the ribs slant backwards. Sowerby's name is taken, though neither his figure nor description is sufficient for identification. *H. Dumortieri* (sp. nov.) is the name now assigned to the form the author previously referred to *H. Ogerieni*, as the distinguishing characters are more strongly marked. *H. illustris*, Denkmann, is more compressed, and has a smaller umbilicus. *H. occidentalis*, Haug, has no tubercles [and therefore should belong to another group]. Haug says it has an oblique inner edge, flexuous, slightly fasciculated [not shown thus in the author's figure] ribs, which disappear at a diameter of 4 in. *H. Eseri*, Oppel. [The author's figures include several species, none of which agree with the type, having a slanting inner edge, fascicled ribs, or too open an umbilicus.] The remainder of the part is occupied by species called *Grammoceras*, whose characters as compared with *Dumortieria* are given, but which the figures do not bear out (*see* pl. xxx., figs. 15—19, and pl. xxxv., fig. 6). The species are *G. toarcense*, D'Orb., *G. striatulum*, Sow.; *G. Mactra*, Dumortier, with fascicled very fine riblets. [Pl. xxx., fig. 5, appears to belong to *G. lotharingicum*, with which it is not compared.] This is said to be mimetic of *Dumortieria Moorei*, from which it differs generically in having a better-marked inferior lateral lobe [though some species, as figured, have it just as feeble]. He has even mixed these "genera" himself in the first three parts of

the Monograph. In connection with this, some sections are given in which individual ammonite zones are said to have a thickness of 4 or 2 ins. *G. subserrodens*, Branco, with fine fascicled ribs [apparently the same as the last—the differences mentioned not being borne out by the figures]. *G. Doerntense*, Denkmann, a more uniformly convex species, with more numerous ribs than *G. toarcense*. *G. Orbignyi* (sp. nov.), possibly a still more rounded species, but yet more compressed, and with a more acute carina. *G. fluitans*, Dum., a strongly, but irregularly-ribbed, species. *G. aalense*, Zieten [obviously including several species, only one of which corresponds with the original]. They are called vars. $\alpha - \delta$ [but no proof is given that they are of the same species]. He states that Dr. Wright has included three genera with six species under this name, and that none of them belong to it. *G. leurum* (sp. nov.), with a subtriangular section, and evanescent ribs and well-marked keel. *G. distans* (sp. nov.), with a few strong ribs rapidly bending to *meet* the keel [does it then belong to this group at all ?]. *G. costulatum*, Zieten, with ribs dying away on the outer third, but few and sharp [possibly not of this group]. *G. subcomptum*, Branco [apparently the same as *G. mactra*, at all events by the description]. *G. lotharingicum*, Branco, with very numerous much-curved ribs, uniting on the inner margin in the earlier part. *G. quadratum*, Haug, quadrate whorls, with coarse subarcuate ribs [apparently of the group called Hildoceras]. *G. subquadratum* (sp. nov.) [obviously identical with the next, the differences assigned not being borne out by the figures]. *G. Sæmanni*, Dum., with very strong curved ribs and open umbilicus, with a strong hollow keel [but apparently including as var. β another solid-keeled species]. *G. fallaciosum*, Boyle, including three species, one = *G. Sæmanni* (α); one like *G. Doerntense*, but with a hollow keel and broader whorls; and one more like var. β. *G. Mülleri*, Denkmann, with outer whorl $\frac{2}{6}$ the diameter, and numerous and very regular sigmoid ribs. *G. metellarium*, Dumortier, with strong fasciated sigmoid ribs and hollow keel, whorls rounded and rather broad. *G. dispansum*, Lycett, not figured, and *G. nannodes* (sp. nov.), a small species with uniform curved striæ, nearly evolute, but with very conspicuous keel. He concludes the descriptions by calling *Amm. discoides*, Zieten, by the new generic title, *Polyplectus*, on account of its complicated sutures. It is to be figured in the next part. He then gives a table of the supposed genetic affinities of these species.

441. Foord, A. H., and Crick, G. C.—On the Muscular Impressions of some Species of Carboniferous and Jurassic Nautiloids compared with those of the Recent Nautilus.

Ann. Nat. Hist., ser. vi., vol. v., p. 220, 6 figures.

The anterior boundary is best preserved. It is seen as a gently curved line on *Solenocheilus latiseptatus*, de Kon., from Glasgow. In a *Nautilus* (sp. nov.) from the Inferior Oolite, Sherborne, it is very forwardly bent. In *N. polygonalis*, from the Inferior Oolite, it is similar. In *N. obesus*, from the Ironstone of Duston, the anterior border, the annulus, and part of the posterior border is seen. The anterior boundary is also seen in *N. clausus*, D'Orb.

442. Foord, A. H., and Crick, G. C.—Descriptions of New and Imperfectly-defined Species of Jurassic Nautili contained in the British Museum (Natural History).

Ann. Nat. Hist., ser. vi., vol. v., p. 265, 18 figures.

The following are the species dealt with:—*N. simillimus* (sp. nov.), differs from *N. striatus* in having a closed umbilicus. *N. Jourdani*, Dumortier, U. Lias. *N. terebratus*, Dum., U. Lias. It has a thickened inner border. *N. robustus* (sp. nov.), U. Lias, France, a broad, smooth species. *N. Fischerianus* (sp. nov.), U. Lias, France, broad-sided, narrow-backed species, with lines of growth only. *N. ornatus* (sp. nov.), Inf. Oolite, Sherborne, umbilicus narrow, form inflated, ornaments fine longitudinal bands, siphuncle extramedial. *N. lineatus*, Sow. This really has flattened sides, broad flattened periphery, *closed* umbilicus, and nearly central siphuncle, and is *smooth*. The name *lineatus* referred only to the "normal line." *N. pseudolineatus* (sp. nov.), Inf. Ool., Dorset and Somerset. It has a slower rate of increase, septa fewer and more concave, siphuncle extramedial. *N. glaber* (sp. nov.), Inf. Ool., Somerset, still further removed in the same direction—*i.e.*, septa more distant and strongly bent, siphuncle more nearly marginal; *N. obesus*, Sow., the shell was smooth. *N. inornatus*, D'Orb. His figure is not good. *N. multiseptatus* (sp. nov.), Inf. Ool., Duston. Differs from *N. obesus* in its closer septa, intramedial siphuncle, more slender whorls, and narrower periphery. [These characters, however, are not borne out by the figures.] *N. clausus*, D'Orb., a rare species. *N. perinflatus* (sp. nov.), Inf. Ool., Bradford Abbas. A transversely rounded species, with very small umbilicus, approximate septa, and thick shell, siphuncle intramedial. *N. Smithii* (sp. nov.), Inf. Ool., Burton Bradstock. A broad species, broadest at the subangular edge of the sloping umbilicus, siphuncle extramedial, shell nearly smooth. *N. Burtonensis* (sp. nov.), Inf. Ool., Burton Bradstock. Compressed, with a wide angular-bordered, steeply-sloping umbilicus, shell thick and smooth, septa distant, and siphuncle intramedial. *N. calloviensis*, Oppel., Calcareous Grit and Kelloway Rock.

443. Foord, A. H., and Crick, G. C.—On some New and Imperfectly-defined Species of Jurassic, Cretaceous, and Tertiary Nautili contained in the British Museum (Natural History).

Ann. Nat. Hist., ser. vi., vol. v., p. 388.

The species dealt with are:—1. *Nautilus lineolatus* (sp. nov.), Inf. Ool., Yeovil, which differs from *N. clausus* by a less rapid increase, open umbilicus, and more compressed form. 2. *N. aganiticus*, Schlot, Inf. Ool., Villecomte, now distinguished from *N. franconicus* by its more inflated form, less flexuous sutures, and intramedial siphuncle; the latter is from the Tithonian; both are figured. *N. portlandicus* (sp. nov.), with a narrow periphery, broadest at the minute umbilicus, sigmoidal septa, central siphuncle; the front is 13 in. by 7½ in. Portland oolite. These three last are referred to the subgenus *Hercoglossa*. *N. radiatus*, Sow. The type specimen is recognised as coming from the Lower Greensand. *N. neocomiensis*, D'Orb., differs from *N. radiatus* in its more compressed form and much finer ornaments; it is confined to Middle Neocomian beds abroad. *N. hunstantonensis* (sp. nov.). Widest in the umbilical region. Umbilicus small, deep, with sloping sides and rounded edges, siphuncle first medial, then extramedial, transverse plications in shell; Red Chalk, Hunstanton. *N. triangularis*, Montf. Has the periphery alternately rounded and sharply angular, with closed umbilicus and triangular section; Lower Chalk, Kent, &c. *N. libanoticus* (sp. nov.). Very broad, with transverse acute ribs—beaks are found with this; Upper Cretaceous, Lebanon. *N. Bayfieldi* (sp. nov.). Compressed on sides, slightly flattened on periphery, umbilicus rather small, deep, and rounded, siphuncle intramedial. Transverse, acute, shallow ribs, with a ventral sinus; Upper Chalk, Norwich. *N. danicus*. Upper Chalk, Faxoe. *N. Cassinianus* (sp. nov.). With compressed triangular whorls—siphuncle almost internal. Its sigmoid sutures place it in the subgenus *Hercoglossa*.

444. Foord, A. H., and Crick, G. C.—A Revision of the Group of *Nautilus elegans*, J. Sowerby.

Geol. Mag., Dec. 3, vol. vii., p. 542.

The authors have identified the type of Sowerby's species in the British Natural History Museum, and point out the errors authors have fallen into about it. There are four allied species of the group:—1. *N. elegans*, with closed umbilicus and central siphuncle; *N. elegantoides* D'Orb., with open umbilicus, and intramedial siphuncle; *N. atlas*, Whiteaves (originally D'Orbigny's *elegans*), of inflated form, closed umbilicus, and extramedial siphuncle, and *N. pseudo-elegans*, D'Orb., still broader, with distinct umbilicus, and intramedial siphuncle. All are from the Lower Greensand. [There is an error in referring Sharpe's figure, Pal. Soc., pl. iv., fig. 2B, to this species as well as to *N. elegans*.]

445. Thompson, Beeby.—The Upper Lias of Northamptonshire, pt. vi.

Journal Northamptonshire Nat. Hist. Soc., vol. v., p. 54. In the notes on fossils the following are described as new species:—*Stephanoceras* (unnamed), allied to *S. annulatum* but "has some features distinct from either this or *S. Holandrei*."

Stephanoceras (unnamed), like *A. fonticulus*, but quite different in the ribbing, viz., single on the side, but double on the back, from tubercle to tubercle.

Dentalium (unnamed), cross section circular, longitudinal lines much more numerous and slender than in *D. liassicum*.

Cerithium seminudum, Wilson (spec. nov.). Early whorls smooth, later ones with wide-spread curved vertical costæ, crossed and nodulated by 5 slender longitudinal lines.

GASTEROPODA.

446. Hudleston, W. H.—Gasteropoda of the Inferior Oolite.

Pal. Soc., pt. i., No. 4, pp. 193—224, pl. xii.—xvi.

This portion deals with the genus *Nerinæa* and breaks off in the middle. The genus commences in the Dogger of Yorkshire, and in the Opalinus zone of the Cottswolds. He divides the genus into five groups:—A. Uniplicatæ, with a simple fold on the outer wall. B. Biplicatæ, with one also on the columella. These two form the subgenus *Nerinella*. C. Triplicatæ, with an extra fold at the posterior end of the columella. D. With two folds on the columella. These two form the genus proper. E. With five folds in all. F. With complex folds. These two form the subgenus *Ptygmatis*.

The Nerinæas of the Inferior Oolite are for the most part feebly ornamented. The folds are less prominent near the aperture. He thinks they may have been absorbed [but perhaps they were only formed in the rear of the animal, as is often the case in other molluscs].

The following are the species described:—A. *Nerinella gracilis*, Lycett; *N. conoidea* (sp. nov.). Spiral angle, 12°. Ratio (of width of whorl to height), 1·25, *i.e.*, less elongate than the last. Four others, unnamed, are recorded from the Lincolnshire Limestone of Weldon. B. Two others, unnamed, from the same locality. C. *Nerinæa parva*, Witchell; *N. oolitica*, Witchell; *N. lonfordensis* (sp. nov.). Spiral angle, 10°. Ratio, 1·4. The whorls are much excavated, and the apical ones thickened at the suture. *N. attenuata*, Witchell; *N. expansa* (sp. nov.). Spiral angle, 15°—17°. Ratio, 1·30. Whorls increasing by steps, not much excavated, later whorls nearly flat, aperture ovate, oblong. Section like *N. oolitica*. *N. deducta* (sp. nov.). Spiral angle, 6°. Ratio, 1·35. Early whorls deeply excavated, later ones quite flat. *N. pseudo-*

cylindrica (D'Orb.); *N. altivoluta*, Witchell; *N. Hudlestoniana* and *N. Eudesii*, Mor. and Lycett; *N. Weldonis* (sp. nov.). Spiral angle, 12°—16°. Ratio, 1·4. Whorls moderately excavated, suture lines prominent. Another smaller specimen is figured as an apical part? [But differs, as figured, in spiral angle, shape of whorl, and ornaments.] *N. zonophora* (sp. nov.). Spiral angle, 14°. Ratio, 1·3 having an extremely prominent and thick sutural carina. *N. subglabra* (sp. nov.). Spiral angle, 12°—13°. Ratio, 1·25. Subulate, whorls flat, granulated spirals and lines of growth. *N. cf. Stricklandi*, Mor. and Lyc. *N. cf. pseudopunctata* (= *N. punctata*, Voltz, of Mor. and Lyc.); *N. cf. elegantula*, D'Orb. New to Britain. D. *Ptygmatis cingenda*, Ph.; *P. subcingenda* (sp. nov.). Spiral angle, 10°. Ratio, 1·4. Whorls excavated, but flat above, with three spiral lines of ornament. E. *P. Guisei*, Witchell. F. *P. campana* (sp. nov.). Spiral angle, 10°. Ratio, 1·8. With very sharp sutural carina. *P. pisolitica*, Witchell; *P. xenos* (sp. nov.). Spiral angle, 4°. Ratio, 1. Whorls flat, lower columellar fold extended longitudinally. *P. bacillus*, D'Orb. New to Britain. *P. Jonesi*, Lycett; *P. oppelensis*, Lycett; *P. producta*, Witchell; *P. consobrina*, Witchell; *P. velox*, Witchell; *P. stroudiensis*, Witchell; *P. cotteswoldiæ*, Lycett, and var. *conica* (= *P. conica*, Witchell); *N. santonis* (sp. nov.). Spiral angle, 8°. Ratio, 1·4. Sides flat. [Description uncompleted on the page.]

447. Boulger, G. S.—On a New Species of *Capulus*.

Proc. Geol. Assoc., vol. xi., p. 445, with pl. iv.

A specimen from the Craigenglen beds of the Carboniferous Limestone of Muirkirk, which shows yellow colour bands on a brown ground. Some historical details are given about the genus *Capulus* and its synonyms, but no reason is assigned for referring the specimen to this genus. It is said, however, not to be a *Naticopsis*, because that has always a close spiral and more globularly inflated body-whorl, and a plain, rounded aperture, and slightly defined concentric lines of growth, and "such consideration drove" him "to the *Calyptræidæ*" [but his figure 6 of a *Capulus* shows "a close spiral," and his fig. 9 "ill-defined concentric lines of growth." The solidity, regularity, flatness on one side, and spiral ornaments, are *not* the usual characters of *Calyptræidæ*.] The name assigned is *C. margarita* (spec. nov.). Apex of one whorl free from second [only partially so by figure] at once widely dilated [ratio of last whorl to penultimate, 7 to 1, as drawn]; spiral apex flat on the right side, which is also flat, back rounded, lines of growth sinuous.

448. Norman, A. M.—Revision of British Mollusca.

Ann. Nat. Hist., ser. vi., vol. v., p. 452; vol. vi., pp. 60, 327.

Tornatina ovata, Jeff., is here recorded as occurring in the British area, and also fossil in the Crags.

PELECYPODA.

449. Ward, J.—The Geological Features of the North Staffordshire Coal-fields.

Trans. N. Staff. Inst. Min. and Mech. Eng., vol. x.

In the lists of fossils are contained the descriptions of two new species, written by **R. Etheridge.** *Anthracomya Wardi*, shell nearly equivalve, margins sub-parallel, right valve largest, rounded anteriorly, obliquely truncated posteriorly. Umbo small, sub-central, an oblique prominent ridge to posterior end, which is flattened above. Surface wrinkled. From Holly Lane Coal, Lower Series. *Sanguinolites granulatus*, Plate i., fig. 12. Shell very inequivalve, elongated, borders sub-parallel, anterior end round, posterior acute and truncated, a ridge to posterior end, surface concentrically plicated and minutely tuberculated, umbones prominent, lunule heart-shaped, huge line straight, grooved three-thirds [? $\frac{2}{3}$] of the length of the shell. Adderley Green. The species figured are called:—*Anthracosia robusta*, *A. aquilina*, *A. acuta*, *A. centralis*, *Anthracomya Adamsii*, *A. carinata*, *A. modiolaris*, *Modiola lithodomoides*, *Sanguinolites granulatus* [*Goniatites Listeri*, *Lingula mytiloides*, *Discina nitida*, *Chonetes Hardrensis*, *Euphoberia ferox*].

BRACHIOPODA.

450. Glass, N.—On a New Form of Spiral in *Spirifera glabra*.

Geol. Mag., Dec. 3, vol. vii., p. 461.

An exceptional specimen of the shell, from the Winnats, Castleton, shows its spiral on one side to have been suddenly restricted to near the posterior border. In this way it is probable that, though the shell has usually a large spiral, M'Coy came to describe it as having a small one.

POLYZOA.

451. Vine, G. R.—A Monograph of the Polyzoa (Bryozoa) of the Red Chalk of Hunstanton.

Q.J.G.S., vol. xlvi., p. 454. Pl. 19. Heading in B.A. Rep., p. 578.

Of the sub-order *Cyclostomata*, he describes the following: *Stomatopora gracilis*, Edw.; *S. divaricata*, Röm., new to Britain; *S. granulata*, Edw.; *S. ramea*, Blainv.; *S. longiscata*, D'Orb.; *S. linearis*, D'Orb., the last two new to Britain; *Proboscina angustata*, D'Orb.; and *P. rugosa*, D'Orb., new to Britain;

P. irregularis (sp. nov.), of very irregular habit, the zoarium made of divergent radial cells. *P. uberrima* (sp. nov.), with three well developed ovicells right across the middle of the zoarium. *P. gracilis*, Reuss; var. *Reussii*; *P. subelegans*, D'Orb., new to Britain. *P. hunstantonensis* (sp. nov.), younger zoæcia simple, older ones flask-shaped, rugose gonæcia flask-shaped, contracted towards the aperture. *P. Jessoni* (sp. nov.), with a narrow branch at first, then fan-shaped; walls of the zoæcia contiguous; some cells (Gonæcia?) have their orifices closed and the closure delicately perforated. *P. gigantopora*, Vine; *P. bohemica*, Novak; *P. Toucasina*? D'Orb.; *P. ramosa*, D'Orb., the last three new to Britain; *P. dilatata*? D'Orb.; *Diastopora hunstantonensis* (sp. nov.), zoæcia irregular, radiating to form a discoid indefinite crust, and wrinkled or punctate on the surface. *D. fecunda*, Vine; *D. irregularis*, D'Orb; *D. radians*, Novak; *D. papillosa*?, Reuss, the last three new to Britain; *D. Jessoni* (sp. nov.), zoarium without marginal lamina, zoæcia long tubes, or slightly flask-shaped, surface finely punctate in transverse rows, closure cells with perforated opercula. *Unitubigera papyracea*, D'Orb.; *Entalophora* (sp.); *Heteropora* (sp.); *Cenopora micropora*, Goldf.; *Reptomulticava simplex*, D'Orb., the last five new to Britain. *R. collis*, D'Orb.; *Zonopora irregularis*, D'Orb.; *Z. variabilis*, D'Orb.; *Multicrescis variabilis*?, D'Orb.; *Unicava collis*, D'Orb., the last four new to Britain. Of the sub-order *Cheilostomata*, he describes *Membranipora gaultina* (sp. nov.), zoarium uniserial, zoæcia elongate, attenuated below, ovate above, area oval, occupying nearly the whole front, the wall below is puckered, branches lateral. *M. fragilis*, D'Orb.; *M. elliptica*?, Hagenow; *M. obliqua*, D'Orb.; *Hippothoa simplex*, D'Orb., the last four new to Britain.

452. Vine, G. R.—Notes on British Eocene Polyzoa.

Proc. Yorks. Geol. and Polyt. Soc., New Ser., vol. xi., p. 154, with plate 5 with 15 figures.

This revises and completes all the known species, viz.: *Dittosaria Wetherellii*, Busk; *Membranipora Lacroixii*, Busk; *M. crassa*? (not figured); *Biflustra eocena*, Busk; *Diachoris intermedia*, Hincks; *Membraniporella nitida*, Johnston; *M. violacea*, Johnst.; *Eschara Brongniarti*, M. Edw.; *Cellepora petiolus*, Lonsd.; *Lunulites urceolata*, Law; *Crisia eburnea*?; *Idmonea coronopus*, Defr.; *I. gracillima*, Reuss; *Hornera flabelliformis*? Blainv.

453. Vine, G. R.—Further Notes on the Polyzoa of the Lower Greensand and the Upper Greensand of Cambridge, pt. ii.

Proc. Yorks Geol. and Polyt. Soc., New Ser., vol. xi., p. 250, pt. xii. with 12 figures.

He gives a list of known Polyzoa for the Lower Green-

sand, Upper Greensand, and Cambridge Phosphate Bed, 90 in all, with notes on *Entalophora proboscidea*, Edw.; *E. lineata*, Bussel; *E. Jessoni*, Vine; *E. neocomiensis*, D'Orb.; *E. gigantopora*, Vine; *Stromatopora linearis*, D'Orb; *E. graciliformis*, D'Orb.; *Proboscina dilatata*, D'Orb; *P. ramosa*, D'Orb.; *P. angustata*, D'Orb.; *Diastopora cretacea*, Vine; *D. Hagenowi*, Reuss; *D. fecunda*, Vine; *D. clementina*, D'Orb.; *D. megalopora*, Vine; *Umbrellina paucipora*, Vine; *Osculipora plebeia*, Novak; *Lichenopora compressa*, D'Orb.; *Membranipora Dumerillii* and *M. cretacea*, D'Orb.; *Microporella antiqua*, Vine. He also gives a list of 31 Foraminifera and 13 Ostracoda from the Cambridge beds

454. Vine, G. R.—A Monograph of Yorkshire Carboniferous and Permian Polyzoa; pt. ii.

Proc. Yorks. Geol. and Polyt. Soc., New Ser., vol. ii., p. 154, pl. vii.

The Carboniferous Polyzoa have a wide range of variation. The species described are *Hyphasmopora Buskii*, Eth. Jr., whose gonocysts are now first described, which are swellings in the stem, with two openings; *Streblotrypa Nicklesii*, Ulr.; *Rhabdomeson gracile*, Phil.; *R. rhombiferun*, Phil., whose ovicell is swollen and has one opening; *Rhombopora lepidodendroidea*, Meek; *Rhombopora similis*, Phil.; *R. persimilis*, Ulr.

[**455.**] **Vine, G. R.** — Report on the Cretaceous Polyzoa.

Read to the British Association in September, but not published in 1890.

INSECTS.

456. Kirby, W. F.—A Synonymic Catalogue of Neuroptera Odonata, or Dragon Flies, with an Appendix on Fossil Species. Gurney & Jackson, 8vo, pp. 202.

The following are the recorded British forms:—*Æschnidium bubas*, Westw.; *Libellulium agrias*, W.; *L. Kaupii*, W.; *L. antiquum*, Brodie, all Purbeck. *Libellula dicaprotata*, Selys, Lias; *Æshna jurassica*, Greb. *Æ. petrificata*, Hag., Purbeck; *Gomphoides Brodiei*, Buckm., Lias; *Heteroplebeia dislocata*, Brod.; and *H. Buckmani*, Brod.; *H. Hopei*, Brod.; *H. liassina*, Strick.; *H. Westwoodi*, Hag., all Lias; *Æschna* [note the *c*] *perampla*, Brod.; and *Agronidium ætna*, W., Purbeck.

457. Brodie, P. B.—On the Character, Variety, and Distribution of the Fossil Insects in the Palæozoic (Primary) Mezosoic (Secondary) and Cainozoic (Tertiary) Periods, with an Account of the More Recent Discoveries in this Branch of Palæontology, up to the Present Day.

Proc. Warwick Nat. and Arch. F. C. for 1889, p. 7.

A general sketch of the state of knowledge on this subject, derived from already published sources.

TRILOBITES.

458. Coignou, Miss—On a new Species of *Cyphaspis* from the Carboniferous Rocks of Yorkshire.

Q.J.G.S., vol. xlvi., p. 421.

This genus is now found for the first time in the Carboniferous Limestone of Pendleside. It is represented by a minute head shield 5 mm. wide by 3·5 mm. long. It shows a characteristic small lobe on each side of the base of the glabella. Its anterior border is semicircular, and had 24 comparatively large spines. The glabella is slightly constricted by two furrows, the surface is granular. It is called *Cyphaspis acanthina* (spec. nov.).

ENTOMOSTRACA.

459. Woodward, H.—On a new British Isopod, *Cyclosphæroma trilobatum*, from the Great Oolite of Northampton.

Geol. Mag., Dec. 3, vol. vii., p. 529, pl. xv.

This occurs in a white crystalline limestone, and shows the upper surface of the cephalon, body segments and telson, the epistomial plate, with traces of antennules and antennæ, and also the left base of the uropodite. It is referred to a new genus *Cyclosphæroma*; it is almost circular, has large eyes, 7 thoracic segments, the first coalescing with the cephalon, the abdominal coalesced. It had two pairs of processes near the telson. From the remarkable form of the cephalon, like that of *Lichas*, among the Trilobites, the species is called *trilobatum*. There are now 27 known fossil Isopods, of which 8 are British. A list of genera is given.

460. Jones, T. R.—Seventh Report of the Committee on the Fossil Phyllopoda of the Palæozoic Rocks.

Rep. Brit. Ass. for 1889, p. 63.

This is a list of the various known forms, with notes of their occurrence. They are *Aristozoe troyensis* and *rotundata*, Olenellus beds, America; *Callizoe armata*, Upper Silurian, Thuringia; *C. primordialis*, Olenus beds, Sweden; *Bactropus decoratus*, Devonian; *Tropidocaris*, sp., Devonian; *Echinocaris*, sp., Devonian, all British. *Nothozoe vermontana*, Potsdam Sandstone; *Protocaris Marshi*, Middle Cambrian; *Ceratiocaris patula?* Upper Silurian; *C. pusilla*, U.S.; *C. cenomanensis; C. Bohemica; C. inæqualis*, L. Silurian, La Sarthe; *C. grandis; Caridolites*, doubtful tracks. *Dithyocaris;* and *Lingulocaris Salteriana*,

L. Silurian, Brittany; *Discinocaris gigas; Estheria; Estheriella*, several species; *Ribeira* is probably a mollusc; *Proricaris Mac Henrici* is made of mixed pieces of other animals.

[**461.**] **Jones, T. R.**—Eighth Report on the Fossil Phyllopoda of the Palæozoic Rocks.

Read to the British Association in September, but not published in 1890.

462. Jones, T. R.—Notes on the Palæozoic Bivalved Entomostraca. No. 29, On some Devonian Entomides.

Ann. Nat. Hist., ser. vi., vol. vi., p. 317, pl. xi.

This begins with a discussion of the occurrence in British Devonian strata of *Entomis serratostriata* (the *Cypridina* of the "Cypridina schiefer"), which is here figured. *E. Richteri* is a new British species, lately referred to *E. Sandbergeri* by the author, but it has the ridges parallel and convergent instead of spiral, and only half the number of those in *E. serratostriata*. *E. gyrata*, Richter, is figured from a British specimen, and *E. variostriata*, Clarke, from a Westphalian one.

463. Jones, T. R.—On Some Fossil Estheriæ.

Geol. Mag., Dec. 3, vol. vii., p. 385, pl. xii.

The author describes and figures *Estheria subquadrata*, Sow., from the Middle Purbeck of the Vale of Wardour, and also figures, without describing, *Estheria membranacea*, from the Old Red Sandstone of Orkney.

[**464.**] **Jones, T. R.**—On some *Estheriæ* and *Estheria*-like Shells, from the Carboniferous Shales of Western Scotland.

Paper read to the Geological Society of Glasgow in March, but not published in 1890.

465. Jones, T. R., and Hinde, G. J.—A Supplementary Monograph of the Cretaceous Entomostraca of England and Ireland.

Pal. Soc. for 1889, pp. 1—70, pl. i—iv.

The Entomostraca herein described have been obtained from the following localities:—1. Upper Chalk, Thorpe, Norwich; 2. Chalk Flint at Horstead; 3. Flint Meal of Antrim chalk; 4. Flint Meal from Keady Hill, co. Londonderry; 5. Chalk from well at Colchester; 6. Chalk of S.E. England; 7. Chalk Flint in Mitcham Gravel; 8. Chalk N.W. of Kemsing, Sevenoaks; 9. Chalk Rock of Beds, Bucks, and Oxon; 10. Chalk Marl at Didcot; 11. Chalk Detritus, Charing; 12. "Upper Greensand" of Cambridge; 13. Upper Greensand of Ventnor; 14. Upper Greensand of Warminster; 15. Upper Greensand of Meux's Brewery; 16. Gault of Folkestone; 17. Gault of Godstone; 18. Gault in Meux's Brewery; 19. Lower Greensand? in Meux's Brewery. Lists from each locality are given.

The following are the species described:—1. *Paracypris gracilis*, Bosquet. 2. *P. siliqua* (sp. nov.), smooth, posteriorly

pointed, anteriorly rounded, lower edge concave, more robust than the last. 3. *Pontocypris trigonalis* (sp. nov.), smooth, subtriangular, largest and rounded in front, straight below. 4. *P. triquetra*, Jones. 5. *P. Bosquetiana* (sp. nov.), punctate, longer and less triangular than the last, thickest at the posterior third. 6. *Bairdia subdeltoidea*, Münster. 7. *B. Harrisiana*, with var. *amplior*. 8. *Macrocypris siliqua*, Jones. 9. *M. Wrightii* (sp. nov.), smooth, lower border sinuate, anterior end small and round, swelling in the hinder third, acuminate posteriorly, large. 10. *M. Münsteriana* (sp. nov.), similar to the last, but not so elongate and more deeply incurved in the antero-posterior region. 11. *M. concinna*, lower side straight, upper side rounded; slightly pointed posteriorly, rounded anteriorly, elongate. 12. *Bythocypris simulata*, Jones; bean-shaped, posterior end subacute. 13. *B. Reussiana* (sp. nov.)=*Bairdia angusta*, Jones; non Münster. 14. *B. silicula*, Jones; and var. *minor*. 15. *B. Brownei* (sp. nov.), uniformly reniform, height half the length. 16. *B. Römeriana* (sp. nov.), with a straighter lower edge, and slight convexity. 17. *B. Icenica* (sp. nov.), almost symmetrically arcuate, *i.e.*, more deeply reniform than (15). 18. *Cythere Bosquetiana*, Jones. 19. *C. Bairdiana*, Jones. 20. *C. Harrisiana*, Jones; and vars. *setosa*, less pitted, and *reticosa*, more pitted. 21. *C. gaultina*, Jones. 22. *Cythereis triplicata*, Römer. 23. *C. auriculata*. Cornuel; broadly ribbed and denticulate in front, with two longitudinal swellings. New to Britain. 24. *C. quadrilatera*, Römer. 25. *C. ornatissima*, Reuss, and vars. *paupera*, ill developed. *C. nuda* = *C. cornuta*, Jones; *C. reticulata*, with reticulate surface more marked; *C. radiata*, with radiating local wrinkling, and *C. stricta* with straight margins. 26. *C. Wrightii* (sp. nov.), subtriangular, rounded in front, dentate behind, dorsal edge with tubercles, subcentral knob very distinct, ventral ridge spinose. 27. *C. tuberosa* (sp. nov.), with two swollen posterior corners beside the subcentral, with a jagged posterior projection, and var. *symmetrica* not so developed. 28. *C. Icenica* (sp. nov.) = *C. macrophthalma*, Jones, non Bosquet; and var. *quadrata*, more quadrate in outline. 29. *C. Lonsdaleana*, Jones. 30. *C. vallata* (sp. nov., Jones MS.). The valve is surrounded by a nearly continuous wall-like ridge, posterior margin suddenly contracted to a point. 31. *C. spinicaudata* (sp. nov.), straight sides converging, ending posteriorly in points; central spine between, and subcentral boss. 32. *Cytheridia perforata*, Römer. 33. *Pseudocythere simplex* (sp. nov.), smooth, suboblong, rounded in front, produced at the postero-dorsal angle, convexity slight. 34. *Cytherura appendiculata*, Jones. 35. *Cytheropteron concentricum*, Reuss, and var. *virginea*, Jones (*cf.* "*Cythere punctatula.*") 36. *C. sphenoides*, Reuss, suddenly thickened just behind and below the middle, dorsal and posterior ends

sloping to become narrow and depressed, the latter serrate. New to Britain. 37. *Cytheropteron alatum*, Bosquet; and vars. *robusta*, with squared outline and spinose posterior edge of wing; var. *fortis*, with the wing further forward, and *cornuta*, with a short angular wing. 38. *C. hibernicum* (sp. nov.), smooth, highest at anterior third, ventral margin overhung by a long broad angular wing, hinder margin with sharp angles. 39. *C. phyllopterum*, Bosquet (= *C. spiculata*, Jones MS.), with sloping sides, irregularly dentate margin, and large vertical spine in the posterior third. New to Britain. 40. *C. cuspidatum* (sp. nov.), straight dorsally, rounded ventrally, produced posteriorly with a sharp, oblique spine from the centre, and var. *montuosa*, with two cylindrical tubercles on the anterior ventral edge, and *tricuspidata*, with the ventral swelling developed into three strong spines. 41. *C. pedatum*, Marsson (= *C. cuspidis*, Jones MS.), sub-oblong, acute behind, with a punctate surface, depressed posteriorly, with a backwardly oblique spine on the posterior third; and var. *salebrosa*, with three transverse furrows on the dorsal region, and short spine. New to Britain. 42. *C. umbonatum*, Williamson, and var. *acanthoptera* (= *C. acanthopterum*, Marsson), with a more swollen body; *longispinata*, larger and more convex, with long and sharp ventral spines, themselves spinose. 43. *C. Sherborni* (sp. nov.), oblong, with concentric punctation, mid-dorsal sulcus well marked, ending in a subcentral pit. 44. *Cytherideis parallela* (sp. nov.), smooth, rhomboidal, posterior end obliquely subacute. 45. *C. acuta*, Alth. (= *C. Wrightii*, Jones MS.), dorsal margin more curved and more oblique posteriorly. 46. *Cytherella ovata*, Römer. 47. *C. obovata* (sp. nov.), more contracted posteriorly. 48. *C. Münsteri*, Römer. 49. *C. subreniformis* (sp. nov.), subreniform, anterior end more boldly rounded, height more than half the length. 50. *C. Williamsoniana*, Jones; and var. *stricta* larger, and with the swellings narrowed and ridge like; and *granulosa*, roughened, with granules and small tubercles. 51. *C. Chapmani* (sp. nov.), small, stout, short, and flat, with a continuous ridge, except on the ventral side, other ridges within. 52. *C. obliquerugata* (sp. nov.), similar in shape, with oblique parallel sinuous, tapering riblets. 53. *C. Mantelliana*, Jones. [Many of the distinctions of these forms are generic, and not here explained, but references are given to former monographs.] Two species, *Pontocypris attenuata?* Reuss, and *Cythere Koninchiana*, Bosquet, are named, not described from the Gault. New to Britain. Of the species described, Nos. 6, 7, 20, 22, 24, 25, 32, 35, 46, 48, 50 range through Chalk, Gault, and Greensand; Nos. 9—12, 15—18, 26—31, 33, 36—41, 44, 45, 47, 49, 51—53 are from the Chalk alone; Nos. 3, 21, 34 are from the Gault alone. No. 8 is absent from the Gault, Nos.

1, 2, 4, 5, 13, 14, 23, 42, 43 are absent from the Greensand, and No. 19 occurs in the Lower Greensand.

466. Jones, T. R.—On some Palæozoic Ostracoda from N. America, Wales, and Ireland.

Q.J.G.S., vol. xlvi., p. 1.

This paper contains descriptions of the following:—*Primitia mundula*, var. *cambrica*; *P. humilis*, var. *humilior*; *P. Morgani* (sp. nov.); *P. Ulrichi*, *P. unicornis*, *Leperditia nana*, all from the Bala beds of Welshpool, and *Xestoleberis Wrightii* from the Lower Silurian, Chair of Kildare. All these are figured.

467. Jones, T. R., and Kirkby, J. W.—On the Ostracoda found in the Shales of the Upper Coal Measures at Slade Lane, near Manchester.

Trans. Manch. Geol. Soc., vol. xxi., p. 137. With a Plate of fossils.

The species are—*Carbonia pinguis*, Jones and Kirkby, the commonest, not before known out of Scotland; *C. secans*, J. and K.; *C. Roederiana* (spec. nov.) near *C. Rankiniana*, but differs in its less relative length and greater angularity of the dorsal and extreme borders; *C. fabulina*, J. and K.; *C. bairdoides*, J. and K., shows the characteristic muscle, spots, and thus the genus is determined, *C. Salteriana*, Jones.

[**468.**] **Smith, J.**—English Upper Silurian Ostracoda.

Paper read to the Glasgow Natural History Society on Jan. 28, but not published in 1890.

ECHINOZOA.

469. Gregory, J. W.—On *Rhynchopygus Woodi*, Forbes, sp., from the English Pliocene.

Geol. Mag., Dec. 3, vol. vii., p. 300.

The echinoderm fragment, to which the specific name was given, was referred to *Echinarachnius* by Forbes. A. Agassiz (Challenger Reports, Zool., vol. iii.) suggested that one of the fragments might belong to *Rhynchopygus* and the other to a *Pourtalesia*. A new specimen in the collection of W. J. L. Abbott shows that all belong to *Rhynchopygus*, the part regarded as the snout of a Pourtalesian being the characteristic supra-anal rostrum now seen in place. A full description, with woodcut, is given, and it is noted that its nearest allies are West Indian Pleistocene fossils, a fact which raises the question how the two could have communicated across the deep Atlantic.

[**470.**] **Gregory, J. W.**—British Fossil Star-Fish.

Paper read to the Hackney Microscopical and Nat. Hist. Soc., Jan. 15, but not published in 1890.

[**471.**] **La Touche, J. D.**—The Asteroideæ of the Upper Ludlow Formation.

Paper read to the Caradoc Field Club on May 30, and reported in the local newspapers.

PELMATOZOA (Crinoids, &c.)

472. Bather, F. A.—British Fossil Crinoids.

Ann. Nat. Hist., ser. vi., vol. v., p. 306. Plate xiv.

This is intended to revise our knowledge of Crinoids in the light of recent researches. The terminology used is [or should be] first given. The "crown" is all but the stem, the "calyx" all but the stem and free arms. The "dorsal cup" and "tegmen" are parts lying below and above the origin of the free arms. Starting from the disc, the lines drawn to the arms are radial lines. The plates on these lines are "infra basals (I.B.)," "radials (R.)," "brachials," the last divided into "costals," "distichals," "palmars," "post palmars," and "free brachials." On the intermediate lines are the "basals (B.)." The oral surface is made up of "interradials," "covering plates," "proximals plates," and "oral plate." [These last not given in this paper]. For comparison, the calyx is placed so that the anal side is nearest the observer when the oral surface is uppermost. The classification followed is that of Wachsmuth and Springer, who make three sub-orders—the *Camerata*, the plates of whose tests are solidly united by suture, and the lower arm-plates form part of the calyx; the *Articulata*, with a pliable test and calyx, including the lower arm joints; and the *Inadunata*, in which the arms are free from the first radials. (*See* also "Nicholson's Palæontology, p. 445). The *Inadunata* are divided into *Larviformia*, without an anal sac, and the *Fistulata* with one. It is with the last of these sub-divisions that the present paper deals. 1st, *The base.* In some families it is monocyclic—*i.e.*, there are no infrabasals—in others dicyclic. The infrabasals, normally 5, sometimes coalesce to 3. 2nd, *The anal plates.* These are special plates in the posterior inter-radius, they support and make room for the ventral sac; they may number from 0 to 3. A long discussion is given of the views, changes of view, contradictions, &c., of various writers who have discussed the homology and phylogeny of these plates, and the author finally regards the plate, often called "azygos," as derived from a radial, and hence he calls it the "radianal (R′.)," the other, called the "special anal," he regards as derived from a brachial, and calls it the "brachianal (X.)." The former is for enlargement, the latter for support.

The Plate of figures [in unnatural horizontal positions,

resembling a collection of hieroglyphics] gives the relations and interpretations of the several plates referred to in the several genera.

Part II. Ann. Nat. Hist., ser. vi., vol. v., p. 373, pl. xv.

3. *The Arms.*—This portion of the paper consists of a [more or less probable] speculation as to the course of development of arms and pinnules, resulting in the conclusion that these are not characters of importance except as a check. "For instance, a pinnulate form cannot be the ancestor of one with simple arms."

4. *The Modes of Union.*—This may be either by "syzygy," when immovable; by "close suture," when the opposed surfaces are smooth; by "loose suture," when there is a more or less developed facet; or by "muscular articulation," when the articular ridge is perforate. These he regards as not of great classificatory importance.

The author then discusses principles of classification and distinguishes between forms connected in a *series* by descent from those separated into *divisions* by divergence. He then gives a geological history of the group [which is merely a sketch of probable relationships as they appear to the author, which may or may not be found correct when the necessary solid work has been done, of which such relationships should be the result, but which at present is guess work], on these lines he draws up a "genealogical tree," and says it is not a tree that follows out the descent of individuals. He puts this in classificatory form as follows:—

Fam. Hybocrinidæ.

Group A.	Fam. 1. Heterocrinidæ.	
	" 2. Calceocrinidæ.	
	" 3. Catullocrinidæ.	
Group B.	Fam. 1. Dendrocrinidæ.	Series Dendrocrinites.
		" Scaphiocrinites.
	Fam. 2. Carabocrinidæ.	
	" 3. Euspirocrinidæ.	
	" 4. Decadocrinidæ.	Series Botryocrinites.
		" Scytalicrinites.
		" Graphiocrinites.
		" Erisocrinites.
		" Encrinites.
		" Cromyocrinites.
	" 5. Cyathocrinidæ.	Series Cyathocrinites.
		" Codiacrinites.
		" Achradocrinites.
	" 6. Belemnocrinidæ.	

The table shows figures of the arms of selected genera, and the explanation contains numerical details on the arms of all the genera.

Part III.—*Thenarocrinus callipyjus*, gen. and sp. nov. Wen-

lock Limestone. Ann. Nat. Hist., ser. vi., vol. vi., p. 222, pl. x.

The generic diagnosis is given in the following technical form—" I B 5, B 5, R 5. Arms simple dichotomous R′ in basal circlet resting on r. post I B, X rests on post B and R′ and only reaches the top of radial circlet." This is really distinguished from all other known Fistulosa by having apparently six basals, one of which, however, is an anal, viz., the Radianal plate dropped into this position. It had a "long and finely ringed column, a well proportioned cup, a delicate ventral sac, and more than myriad arms."

473. Carpenter, P. H.—On certain Points in the Anatomical Nomenclature of Echinoderms.

Ann. Nat. Hist., ser. vi., vol. vi., p. 1.

For the future in a Crinoid he will call the radial plates in order the *suprabasals*, the *radials*, the *first costals*, and the *second costals*, and more costals, if necessary, till the *axillary* is reached. The intraradial plates he will call *basals*, and corresponding changes will be made in his Crinoid formulæ, taking "C" to represent costal instead of R, and changing the a, b, c of the cirri to x, y, z.

[**474.**] **Carpenter, P. H.**—Notes on the Morphology of the Cystidea.

Paper read to the British Association on Sept. 9, but not published in 1890.

CORALS.

[**475.**] **Young, J.**—Notes on the Structure of a Carboniferous Coral *Chætetes* (*Alveolites*) *septosa*, Fleming.

Paper read to the Geological Society of Glasgow on May 29, but not published in 1890.

GRAPTOLITES.

476. Nicholson, H. A.—Note on the Occurrence of *Trigonograptus ensiformis*, Hall, sp., and of a variety of *Didymograptus v. fractus*, Salter, in the Skiddaw Slates.

Geol. Mag., Dec. 3, vol. vii., p. 340.

Gives reasons, with figures, for the assignment of the above names to the specimens found. The *Trigonograptus* was obtained in the Ellergill beds in one of the feeders of Moredale Beck, near Troutbeck. The *Didymograptus*, which differs from *D. v. fractus* in having the two branches in the same straight line in opposite directions, he names var. *volucer*. It was obtained at Outerside Keswick.

RADIOLARIA.

477. Dr. Hinde (Geol. Mag., ser. iii., vol. vii., p. 144) states that a chert rock in the Ballantrae series (Llandeilo Caradoc) is composed of Radiolarians.

478. Hinde, G. J.—Notes on Radiolaria from the Lower Palæozoic Rocks (Llandeilo-Caradoc) of the South of Scotland.

Ann. Nat. Hist., ser. vi., vol. vi., p. 40, pl. iii. and iv.

These are found above the black shale of the Glenkiln series, and below the black shale with Lower Hartfell graptolites. The Radiolarians are found in chert bands, which are almost entirely composed of them. It may, therefore, be called a *pure* Radiolarian rock. Such rocks are said by Hæckel to be "certainly of deep sea origin" [?], in which case this is an oceanic deposit. Only one species of Radiolarian has hitherto been described from Palæozoic rocks, and none at all in Britain, and very few in any British formation. This, therefore, is an entirely new opening. The species, with one doubtful exception, all belong to the sub-class *Spumellaria.* These are considered, from an anatomical point of view, to be more primitive than the other sub-classes, and this corresponds to their earlier occurrence. [This sub-class, however, is said to characterise the Pelagic or upper zone in the ocean, and, consequently, shows: 1. that this deposit need not be a deep sea one; 2. that pure radiolarian ooze may occur without the presence of "abyssal" forms.] The following are the species described, Order *Sphærellaria*: 1. *Styptosphæra antiqua* (sp. nov.), a solid spongy sphere without radial spines. 2. *Spongoplegma priscum* (sp. nov.), a loose spongy sphere with a single latticed medullary cell. 3. *Diploplegma* (gen. nov.) *cinctum* (sp. nov.); two concentric spongy spheres, connected by radial bars. 4. *Staurodoras gracilis* (sp. nov.), a spongy sphere with four crossed simple spines. 5. *Stauroplegma* (gen. nov.) *brevispina* (sp. nov.), a spongy sphere with inner medullary shell and four cross spines; in this species short and the sphere smooth. 6. *S. compressum* (sp. nov.) has an uneven surface and spines two-thirds diameter of sphere. 7. *S. barbatum* (sp. nov.), sphere rough, almost prickly, spines longer than its diameter. 8. *S. diffusum* (sp. nov.), sphere irregular and uneven, spines less than its diameter, possibly with second medullary test. 9. *Acanthosphæra antiqua* (sp. nov.) has a simple latticed sphere, with simple radial spines, the openings are large and sub-circular. 10. *Haliomma vetustum* (sp. nov.), with one medullary and one cortical shell connected by radial beams (not seen in these specimens), externally spined. In this species the spines are numerous, stout, and conical. 11. *H. cornutum*, in this the spines are fewer and

more slender. The remaining species cannot be assigned to any of Hæckel's families. 12. *Dorysphæra* (gen. nov.) *reticulata* (sp. nov.), with a simple spherical lattice shell and a single spine. In this species the lattice is medium sized, the spine styliform. 13. *D. nucula* (sp. nov.), with a closer lattice work and short spine. 14. *D. laxa* (sp. nov.), with a more open lattice work. 15. *Doryplegma* (gen. nov.) *nasutum* (sp. nov.), with an irregular reticulate sphere, a medullary shell, and single spine. In this species a more open network and shorter spine. 16. *D. gracile* in this with closer network and longer spine. 17. *Dorydictyum* (gen. nov.) *simplex* (sp. nov.), spongy sphere, with single radial spine. 18. *Triposphæra* (gen. nov.) *Peachii* (sp. nov.), spongy sphere, with medullary shell and three primary radial spines. This species has tapering spines twice the diameter of the sphere. 19. *T. hastata* (sp. nov.), spines more robust, medullary test smaller. 20. *T. densa* (sp. nov.), spines shorter than the diameter of the sphere. 21. *T. armata* (sp. nov.), with numerous secondary spines, primaries equal the diameter. Order *Collodaria*. 22. *Sphærozoum priscum* (sp. nov.), separate spicules of four (or three) irregularly placed rays. 23. *S. patulum* (sp. nov.), spicules geminate or cruciform. The subclass *Nasellaria* is possibly represented by spiny more or less complex radiating spines. All these are seen best when the rock has been naturally discoloured.

479. On Feb. 26, Dr. Hinde exhibited at the Geological Society some microscopic sections of the Radiolarian Chert from the southern uplands of Scotland, and stated that these showed the rock to be filled with minute spherical bodies, in one case consisting of simple or concentric lattice-like shells with relatively long radial spines. *See* Proc. Geol. Soc., p. iii. (in Q.J.G.S., vol. xlvi.).

[**480.**] **Hinde, G. J.**—A Discovery of Chert with Radiolarians in Palæozoic Rocks.

Paper read to the Croydon Microscopical and Natural History Club on April 9, but not published in 1890.

SPONGES.

481. Hinde, G. J.—On a New Genus of Siliceous Sponges from the Lower Calcareous Grit of Yorkshire.

Q.J.G.S., vol. xlvi., p. 54.

In the sandy beds at the base of the calcareous grit of Filey Brig are some minute reniform bodies which were once considered to be Foraminifera, but later to be globate sponge spicules, which were originally siliceous, but the difficulty was that they were not accompanied by acerates,

as similar bodies are in *Geodia*. A specimen, however, has now been found, preserved in the York Museum, which is evidently, from its form, a sponge. A section through this has shown that the spicules are entirely of this reniform character, so that their nature is no longer in doubt. The minute pitting on the surface, which led to their being considered foraminiferous, is shown to be caused by the ends of radiating interior fibres. In this respect, and in the abundance of globates, the sponge is nearly allied to the recent *Placospongia*, which has a layer of pin-like spicules, which it is not impossible the present form may have had and lost. The specimen is named, generically, *Rhaxella*, the name *Renulina* being preoccupied [and being unsuitable from its termination, which indicates a foraminiferous relationship]. The specific name given is *perforata* [but, according to the laws of priority, it ought to be *Sorbyana*, the name given to the spicules in 1876, so that it ought to stand as *Rhaxella Sorbyana*].

MICRO-ORGANISMS.

[**482.**] **Holmes, W. M.**—On Glauconite Casts from the Godstone Firestone.

Paper read to the Croydon Microscopical and Natural History Club on Sept. 2, but not published in 1890.

[**483.**] **Bailey, G.**—The Tenants of a Fossil Echinus.

Paper read to the Croydon Microscopical and Natural History Club on April 9, but not published in 1890.

484. Wethered, E.—On the Occurrence of the Genus *Girvanella* in Oolitic Rocks, and Remarks on Oolitic Structure.

Q.J.G.S., vol. xlvi., p. 270.

The author has already described a *Girvanella* from the Pea Grit as *G. pisolitica* (Geol. Mag., 1888, p. 22). The present are additional. Two species occur in the Carboniferous Limestone of Clifton. In this series there are four oolitic beds. The three lower resting on dolomitic limestones have no Girvanella. The top, or "New Road" oolite, may be divided into four minor beds. No. 2 from top contains *G. incrustans*, the others *G. Ducii*. The genus consists of minute curling tubes from ·007 to ·02 mm. in diameter, sometimes incrusting a central nucleus, sometimes forming a nucleus to a granule, and sometimes scattered. When they coil round parallel to the nucleus they give the idea of concentric structure, and this seems the nearest approach they make to a true oolitic grain. The figures show that the nests of *Girvanella* are irregular in outline. *G. incrustans* is ·01 mm. in diameter, and clings to an object, parallel to its

surface in the type, and irregularly in var. *Ducii* from the Inferior Oolite of Chedworth. *G. Ducii* is ·02 mm. in diameter, either separate or clinging to an object. *G. minuta* is ·007 mm. in diameter, either in a separate aggregation or upon an object, from the Coralline Oolite, Weymouth. *G. intermedia* is ·01 mm. in diameter, and grows in nodular masses in the same beds. *G. pisolitica* is a little larger, and runs parallel to the object in the Upper Freestones of Chedworth and the Pea Grit. In no other beds of Great or Portland Oolite examined were these organisms found. [It is plain from this paper that small pebbles, either entirely or partly made of *Girvanella*, are found in oolitic beds, and have been confounded with true oolitic grains, but that they differ entirely from the latter, the nature and origin of which is untouched by these discoveries.] They are compared to Foraminifera, but their place in the animal kingdom is left undetermined.

PALÆOBOTANY.

485. Williamson, W. C.—On the Organisation of the Fossil Plants of the Coal Measures. Part xv.

Phil. Trans., vol. 180B, p. 155, p. 195, pl. i.—viii.

In Plate i., he gives magnified transverse sections of a *Rhachiopteris* stem. The centre has a five-rayed medullary cavity, surrounded by scalariform tracheids, some carbonised cortical tissue, and a surrounding sheath of possibly cellular structure. The rays appear to give off vascular axes, like the above, but he has one now in which this form (the Anachoropterid) is associated with one in which the bundle is rail shaped (the Zygopterid). He thinks the former belongs to the rhizome, and the latter to the petiole, of one plant, which he calls *R. Grayi*. In fig. 6 is a section of *R.* (*Zygopteris*) *Lacattii*, Renault, showing its gum canals in the inner cortex, and the bifurcation for the double pinnules.

He next shows additional details of the fructification called *Calamostachys Binneyana*. First an oblique section through the axis of the strobile, showing the tracheids aggregating at four points round the central parenchyma. Next, a transverse section, showing many details—viz., central axis invested by a cortical zone, and beyond this a circle of fertile sporangiophores with enlarged shield-like extremities, and bundles of tracheids at the margins of these, where the sporangia join the sporangiophores, as in the modern equise-

tum. Under the name of *Rhachiopteris hirsuta*, he figures and describes some sections of stems with central axis, inner and outer cortex, and radiating rootlets which most resemble those of *Marsileæ*. Some roots, with a central vascular axis with barred vessels, cortical parenchyma, and rootlets in verticills, he calls *Rhizonium verticillatum*. Another figured rootlet shows a narrow central axis, a loose lacunar inner cortex, and a compact epidermal layer—indicating a water plant. This he calls *Rhizonium reticulatum*. A third has a thicker external cortex, and thin, one-celled vertical plates projecting inwards as an inner cortex, and a vascular axis and sheath. This is *Rhizonium lacunosum*.

Part xvi., p. 195, with plates v.—viii.

Six successive figures illustrate the branching of the vascular axis of *Lepidodendron Harcourtii*. Part of the vascular cylinder separates along two radii, and, commencing as part of a circle with a small portion of the medulla near the centre, the two sides gradually close in, and form a round bundle, absorbing the remains of the medulla, which must afterwards develop again.

Plate vi. and plate v., fig. 15, illustrate the structure of a new form, *Lepidodendron mundum*, characterised by its medullary vascular cylinder consisting of a single circle of large scalariform tracheids, surrounded by a fringe of many smaller ones. As the stem grows, medullary cells arise in the centre. In one specimen, the axial cylinder is surrounded by a broad exogenous zone. Sections of a new specimen, *L. intermedium*, figs. 16—18, show a medullary axis with large barred tracheids irregularly disposed towards the circumference, and within the parenchymatous medulla, and having an undulating longitudinal section. Beyond this is a narrow well-defined ring of very fine exogenous tracheids $\frac{1}{1800}$—$\frac{1}{2800}$ in. in diameter, with interspersed cells, and beyond this the epidermis. *Lepidodendron Spenceri* shows a solid central vascular axis, whose tracheids are most barred near the circumference, and very thin-walled centrally, showing a centripetal growth. The middle cortex, with an undulating outline, has alternate patches of dark thick-walled and light thin-walled cells. *L. parvulum* is the smallest known. It has a distinct medulla, and an axial cylinder of two rows of tracheids. The middle cortex is of small cells, and is always complete, the outer cortex of very uniform sized cells, and between the middle and outer cortex are empty places, leaving radial bands. The empty spaces have been occupied by very thin-walled tissue seen in one specimen.

As the normal ramification of *Lepidodendron* is dichotomous, the monotaxial must be special, he suggests it is to support strobiles—some of which had long and pendulous stems.

Some were lateral and nearly sessile. Exogenous growth takes place at some stage or another in all *Lepidodendra.* The increase in size of the medulla of the vascular axis is peculiar. It is not constantly present and finally decreasing, as in living exogenous plants, but some growth of the plant takes place without any medulla being visible; but at last, as the stem grows, it appears and then constantly increases, and is the cause, by its tension, of the swelling of the vascular cylinder, a condition only remotely paralleled among ferns. The young branches from a stem with a large medulla are, nevertheless, solid. *Rhachiopteris irregularis* is the name of a section showing a cortex of uniform tissue and a rail-shaped axial cylinder, the swollen parts hollow and the cells on one side longitudinally larger than on the other.

486. Williamson, W. C.—Report of the Committee appointed to Investigate the Flora of the Carboniferous Rocks of Lancashire and West Yorkshire.

Rep. Brit. Ass. for 1889, p. 69.

Only an intimation that the writer has a large quantity of material accumulated and slides prepared from coals of various regions of the world. He also notes that since the stem *Lyginodendron Oldhamium* belongs to the fronds called *Rhachiopteris aspera*, carboniferous ferns, as well as other cryptogams, grew exogenously.

487. Williamson, W. C.—On the Organisation of the Fossil Plants of the Coal Measures, pt. xvii.

Proc. Roy. Soc., vol. xlvii., p. 294.

Rhachiopteris aspera is identified as the foliar rhachis of *Lyginodendron.* So, though it possesses an exogenous vascular zone, with xylem and phloem elements, it has been a true fern. Thus, all these groups of vascular cryptogams exhibit the structure of modern angiosperms. The *Lyginodendron* also shows a development of a medulla within a large central vascular bundle. *Heterangium Grievii* has been shown to possess an exogenous xylem zone. He has now found some without, hence it is a product of a more advanced growth. He has found the stem of *Bowmanites*, and its structure is allied to that of *Sphenophyllum.* Small calamite stems produce no fluted cast, because the inside is not absorbed as far as the vascular bundles.

488. Hick, T., and Cash, W.—The Structure and Affinities of *Lepidodendron.*

Proc. Yorks. Geol. and Polyt. Soc. New Ser., vol. xi., p. 316, pl. xvi.

The object of this paper is to discuss the relationship between *Lepidodendron*, *Lycopodium*, and *Sellaginella*, and the authors commence by giving an account of the root, stem, leaves, and fruit of *Lepidodendron* as now known. With

regard to the stem—a transverse section of which is figured on the plate—they note that it consists of (*a*) a central axile vascular cylinder, representing one or more vascular bundles and consisting of (1) a central string of xylem enclosed by (2) a zone of phloem; (*b*) an outer mass of tissue, forming the cortex, and divisible into (1) the inner parenchyma, (2) the outer hypoderma. These are the primary elements, supplemented by secondary growth in two places, (1) in the axile vascular cylinder, between the xylem and phloem, forming a "vascular zone," (2) in the hypoderma of the cortex, giving rise to a sclerenchymatous phelloderm; both these growths originate in cambium. With regard to the fruits, they note that though heterosporous fruits have been described, large fragments are homosporous, *i.e.*, with microspores only. In comparing *Lepidodendron* with *Lycopodium*, they are found to agree in (1) their leaves, (2) their one axile vascular cylinder, probably of compound origin, and (3) of circular section, (4) their xylem plates developing centripetally (in some at least), (5) having a homogeneous hypoderm when young, which (6) passes into the leave tissues. But they differ in *Lepidodendron* having (1) a pith, (2) an unbanded xylem, and consequently (3) no phloem between the bands, (4) no phloem or bundle sheath (though such may yet be found), (5) its hypoderma less sclerenchymatous. In comparing *Lepidendron* with *Selaginella* they agree (1) in their thickened hypodermic cells, (2) in their thin-walled elements of the inner parenchyma. But *Lepidodendron* differs by (1) its circular and compound (?) axile vascular bundle, (2) the absence of a phloem sheath, (3) the absence of an air cavity round the vascular bundle. They conclude that *Lepidodendreæ* should form a separate series of the *Lycopodineæ*.

[**489.**] **Cash, W., and Lomax, J.**—On *Lepidophloios* and *Lepidodendron.*

Paper read to the British Association on Sept. 5, but not published in 1890.

[**490.**] **Lomax, J.**—Recent Researches into the Organisation of the Plants of the Coal Measures.

Paper read to the Bury Literary and Scientific Society, June 19, but not published in 1890.

491. Kidston, R.—Notes on the Palæozoic Species mentioned in Lindley and Hutton's "Fossil Flora."

Proc. Roy. Phys. Soc. Edinburgh, 1889-90, p. 345.

These notes follow the plates from end to end, giving notes on each and stating their present identification. The following are the chief. *Pinites Brandlingi* is a *Cordaites; Lepidodendron Sternbergii*, *dilatatum* and *gracile* are *L. ophiurus*, Brong.; *L. acerosum* is a *Lepidophloios; L. selaginoides* is *Bothrodendron minutifolium; Sphenophyllum erosum* is *S. cuneifolium; Astero-*

phyllites tuberculatus he re-names *Stachannularia northumbriana; Calamites nodosus* (pl. xv.) is the stem of *C. ramosus* with the foliage of a *Palæostachya; Asterophyllites longifolia* (18) is a *Calamocladius; Bechera grandis* (19) is the stem of *Sphenophyllum; Asterophyllites grandis* (19) is *Calamocladius equisetiformis* Schl. sp.; *Peuce Withami* (23—4) is a *Cedroxylon; Asterophyllites foliosa* (25) is *Annularia radiata*, and *Asterophyllites galioides* (25) is an *Annularia. Lepidostrobus ornatus* (26) is a well preserved specimen of *L. variabilis*, figured upside down; *Sphenophyllum Schlotheimi* (27) is *S. emarginatum; Noeggerathia* is now called *Psygmophyllum; Pecopteris adiantoides* (37) is *Neuropteris heterophylla; Pecopteris heterophylla* (38) is *Alethopteris decurrens; Odontopteris obtusa* (40) = *O. Lindleyana; Neuropteris cordata* (41) is *N. Scheuchzeri; Sphenopteris affinis* (45) is a *Calymmatotheca; S. crithmifolia* (46) is *Eremopteris artemisæfolia; S. dilatata* (47) is *S. trifoliata; S. caudata* (48) is *Dactylotheca plumosa; Neuropteris Loshii* (49) and *N. Soretii* (50) are *N. heterophylla; Sphenopteris bifida* (53) is a *Calymmatotheca; Sigillaria oculata* (59) is *S. ovata; Favularia tessellata* (73-5) is a *Sigillaria; Cardiocarpon acutum* (76) is a *Cordaianthus; Calamites approximatus* (77) is *Calamitina varians* var. *Schutzei; C. cannæformis* (89) is *C. Suckowii; Halonia tortuosa* (84) is the fruit of *Lepidophloios regularis; Halonia gracilis* (86) is a *Lepidodendron; Carpolithes alata* (87) is *Trigonocarpus Parkinsoni; Cyclopteris obliqua* (90) and *C. dilatata* (91b) are *Neuropteris heterophylla; Pecopteris nervosa* (94) and *P. laciniata* (122) are *Mariopteris muricata; Knorria taxina* (95) is the stem of *Cordaites; Sphenopteris crenata* (100) and *S. adnascens* (101) are identical; *Pecopteris serra* (107) is *Dactylotheca plumosa; Lepidodendron Sternbergii* (112) and *L. elegans* (118 and 199) are *L. ophiurus; Megaphyton distans* (117) is *M. frondosum; Asterophyllites equisetiformis* (124) is *Annularia stellata; Cyclocladia major* (130) is *Calamitina varians; Asterophyllites jubata* (133) is *Calamocladus longifolius; Sphenopteris caudata* (138) is *Dactylotheca dentata; Caulopteris gracilis* (141) is the vascular axis of a *Stigmaria; Trigonocarpum Noeggerathii* (142c) is *T. Parkinsoni; Pecopteris Mantelli* (145) is *Alethopteris decurrens; Otopteris dubia* (150) is a *Rhacopteris; Lepidophyllum trinerve* (152) is *L. majus; Pecopteris lonchitica* (153) and *P. Serlii* (202) are *Alethopteris; Pecopteris dentata* (154) is *Dactylotheca plumosa; Sphenopteris latifolia* (156, 177) is *S. obtusifolia; Pinus anthracina* (164) is the back of a *Lepidophloios*, and not a cone; *Bechera grandis* (173) is a *Calamocladus; Neuropteris attenuata* (174) is a *Pecopteris; Pecopteris abbreviata* (184) is *P. Miltoni; Hippurites longifolia* (190, 191) is *Calamocladus equisetiformis; Trigonocarpum Noeggerathii, T. olivæforme* (222), and *T. oblongum* (193) are all *T. Parkinsoni; Neuropteris heterophylla* (197) is *N. gigantea; Lepidostrobus pinaster* (198) is part of the bark of *Lepidophloios acerosus; Sphenopteris Höninghausi* (204) is *S. effusa; Lepidodendron*

plumarium (207) is a leafy branch of *L. ophiurus*. *Pecopteris marginata* (213) is probably *Mariopteris muricata*; *Pecopteris areopteridis* (215) is *P. Miltoni; Calamites approximatus* (216) is *C. cruciatus; Cyclopteris oblata* (217) is part of a *Neuropteris; Pecopteris Bucklandi* (223) is *Neuropteris rarinervis; Halonia regularis* (228) are fruiting branches of *Lepidophloios; Sphenopteris linearis* (230) is the upper part of *S. crassa*.

The figures on the following plates are indeterminate: 17, 19 (1), 20, 21, 22, 54, 55, 56, 57, 58, 59, 70, 71, 72, 84, 86, 90, 91a, 91b, 97, 108, 113, 140, 142b, 149, 161, 174, 183, 196, 203, 205, 206, 211, 217, 223, 227a.

492. Kidston, R.—On the Fossil Plants in the Ravenhead Collection in the Free Library and Museum, Liverpool.

Trans. Roy. Soc. Edinburgh, vol. xxxv., p. 391, with two plates.

An introduction by **G. F. Morton** gives the geological position of the strata whence the plants have been derived. The Coal Measures of Lancashire are divisible into three portions. The Lower Measures or Gannister beds at Billinge are 1,881 ft. thick, and are mainly unproductive. The Middle Measures contain all the important coals, the highest being Lyon's Delf and the lowest the Little Delf, which is equivalent to the Arley Mine. This portion is 1,320 ft. thick at Prescot, 1,739 ft. at St. Helens, 2,172 ft. at Wigan. The Upper Measures are about 1,200 ft. thick, and contain no workable coal seams. The Ravenhead coals occupy about the middle of the main ccal series, and occur in the St. Helens district. They are equivalent to the Fenland coal at Prescot and the Wigan 5 ft. main. The plants were obtained from a railway cutting at Ravenhead, where two seams of coal are exposed. The upper lies below the Thatto Heath Sandstone, and is separated by 4 ft. of strata from the lower. At about 8 ft. below this was a forest of erect trees 4 or 5 ft. high, with roots, and in the black shales and nodules below this the plants for the most part occurred. The series is almost immediately cut off on the west by a fault, which brings down the Thatto Heath Sandstone. A section is drawn.

The following are the species named:—

Calamitina varians, Sternb., var. *inconstans*, pl. i., fig. 1, a stem showing 40 nodes in about 1 ft., which belong to two complete and two incomplete branch scar periods. The leaf scars are triangular from compression. *C. approximatus*, Brong.; *Eucalamites ramosus*, Artis; *Stylocalamites Suckowii*, Brong.; *S. undulatus*, Sternb.; *S. Cistii*, Brong.; *Calamocladus equisetiformis*, Schloth.; *C. grandis*, Sternb.; *C. lycopodioides*, Zeiller; *Sphenophyllum cuneiformum*, Sternb.; *Sphyropteris obliqua*, Marrat, pl. i., fig. 3; a remarkable genus, with free exannu-

late hemispherical sporangia, in oblique transverse elevated rows on modified expansions at right angles to and terminating the pinnules of the frond. They have radiating walls, like a coral, with central depression. *Zeilleria delicatula*, Sternb.; *Sphenopteris Sauveurii*, Crépin; *S. trifoliolata*, Artis. (None of the foreign references to this species are correct.) *S. Marratii*, spec. nov. (=*S. gymnogrammides*, pl. ii., figs. 1, 2). This differs from the last named in habit and in having smaller and less characteristically trilobate pinnules, especially in the lower part of the frond. *S. obtusifolia*, Brong.; *S. mixta*, Schimper (= *S. pulchra*); *S. coriacea*, Marrat, pl. i., fig. 4; *S. Footneri*, Marrat, pl. ii., fig. 3, probably = *S. gracilis*, Brong.; *S. spinosa*, Göpp.; *S. furcata*, Brong.; *S. multifida*, L. and H.; these specimens, if rightly referred to this species, show that it cannot be united to *Urnatopteris tenella*, Brong., as stated in the author's catalogue; *S. Sternbergii*, Ett.; *Neuropteris heterophylla*, Brong.; *N. tenuifolia*, Schl.; *N. gigantea*, Sternb.; *N. macrophylla*, Brong.; *N. dentata*, Lesq. (= *N. denticulata*), pl. ii., fig. 5; *Odontopteris Reichiana*, Gutbier (= *O. neuropteroides*, Marrat); *O. britannica*, Gutbier; *Mariopteris muricata*, Schl.; *Pecopteris Miltoni*, Artis; *Dactylotheca plumosa*, Artis; *Alethopteris lonchitica*, Schl., and var. *decurrens*; *A. Serlii*, Brong.; *Rhacophyllum crispum*, *Megaphyton frondosum*, Artis; *Lepidodendron Sternbergii*, Brong.; *L. aculeatum*, Sternb.; *L. Haidingeri*, Ett.; *Lepidostrobus variabilis*, L. and H.; *L. Obryi*, Zeiller; *L. Geinitzii*, Schimper; *Lepidophloios carinatus*, Weiss; *Halonia regularis*, L. and H.; *Lepidophyllum lanceolatum*, Brong.; *Bothrodendron minutifolium*, Boulay (= *Lycopodium carbonacium*, Feistm., pl. ii., fig. 6); leaves linear lanceolate, single nerved, tapering to a fine point; *Sigillaria tessellata*, Brong.; *S. mammillaris*, Brong.; *S. arziniensis*, Corda, pl. i., fig. 2; *Stigmaria ficoides*, Sternb.; *S. rimosa*, Goldf.; *Cordaites principalis*, Germar; *Antholithus*, sp., *Sternbergia approximata*, Brong.; *Trigonocarpus Noeggerathii*, Sternb., pl. ii., fig. 4, larger than *T. Parkinsoni*, Brong.; *Pinnularia capillacea*, L. and H.

493. Kidston, R.—On some Fossil Plants from Teilia Quarry, Gwaenysgor, near Prestatyn, Flintshire.

Trans. Roy. Soc. Edinburgh, vol. xxxv., p. 419, with two plates.

These plants occur at the base of the Upper Black Limestones—the uppermost local division of the Carboniferous Limestone series—and they are all drifted specimens, the associated fossils being marine. For the most part, therefore, they are badly preserved. They are *Asterocalamites scrobiculatus*, Schl.; *Adiantides antiquus*, Ett; pl. i., fig. 1. [no fructification seen]. *Rhacopteris flabellata*, Tate; pl. i., fig. 2; pl. ii., figs. 4—7 (fig. 4 from Burdiehouse);

R. inæquilatera, Göpp.; *Archæopteris*, sp.; *Sphenopteris subgeniculata*, Stur., pl. ii., fig. 10; *S. Teiliana*, spec. nov., pl. i., fig. 3. Frond bipinnate, main rhachis divided into two equal parts by an acute angled dichotomy, pinnæ oblong alternate, pinnules alternate, fan-shaped, composed of 1—2 bifid-cuneate segments; on the main rhachis, below the bifurcation, are placed distant pinnules of the ordinary type, *S. pachyrhachis* Göpp.; *S. Schlehani*, Stur. He concludes from the resemblance of the flora of this rock to that of the Calciferous Sandstone of Scotland, that these two beds [the top of the so-called Mountain Limestone] are on the same horizon.

494. Kidston, R.—The Yorkshire Carboniferous Flora. Trans. Yorkshire Nat. Union, pt. 14, for 1888.

The species here recorded are in no case determined by the internal structure. The table of the Yorkshire Coal Measures is taken from Green's Memoir, but the line between Middle and Lower Coal Measures is taken at the Elland Fags.

The works already written on this subject are: *Steinhauer* "On Fossil Reliquiæ of Unknown Vegetables in the Coal Strata," 1818; nine species named, only one of which is now accepted. *Artis*, "Antediluvian Phytology," 1825 (or 1838); eight of his species are still received. The other two mentioned are Brongniart, and Lindley and Hutton. The later writings deal with structure or add nothing.

The following are the species recorded: M., L. = Middle or Lower Coals. CALAMARIÆ.—*Calamitina varians*, Sternb., M.; *C. Göpperti*, Ett., M. and L.; *C. verticillata*, L. and H., M. not really recognised; *Eucalamites ramosus*, Artis, M.; *E. cruciatus*, Sternb., M.; *Stylocalamites Suckowii*, Brong., M., L., and Millstone Grit; *S. undulatus*, Sternb., M.; *S. Cistii*, Brong., M.; *S. schatzlarensis*, Stur., M.; *S. approximatus*, Brong., M.; *Calamocladus equisetiformis*, Schl., M.; *C. Roehli*, Stur., M.; *Calamostachys cf. longifolia*, Weiss, M.; *C. typica*, Schimper, M.; *Palæostachya pedunculata*, Will., M.; *P. gracillima*, Weiss, M.; *Macrostachya*, sp., M.; *Annularia microphylla*, Sauveur, M.; *Sphenophyllum cuneifolium*, Sternb., M. and var. *saxifragifolium*, *S. majus*, M.; *S. cf. oblongifolium*, Germar, M.; *S. myriophyllum*, Crépin, M.; *S. trichomatosum*, Stur., M.

FILICACEÆ.—*Sphenopteris obtusifolia*, Brong., M.; *S. trifoliolata*, Artis, M.; *S. latifolia*, Brong., M.; *S. acuta*, Brong., M.; *S. spinosa*, Göpp., M.; *S. cristata*, Brong., M.; *S. crenata*, L. and H., M. (*Schizopteris adnascens* is part of this fern); *S. Höninghausi*, Brong. M.; *S. Laurenti*, André, M.; *S. Footneri*, Marrat, M.; *S. Zobelii*, Göpp., M.; *S. Sternbergi*, Ett. M.; *S. cf. furcata*, Brong. M.; *Renaultia schatzlarensis*, Stur., M., very fine fruiting specimens, *S. Schutzii* is probably a synonym; *Crossotheca*

schatzlarensis, Stur., M.; *Oligocarpia Brongniarti*, Stur., M. (*Urnatopteris tenella*, Brong., recorded as from Yorkshire, but not found); *Mariopteris muricata*, Schl., M.; var. *nervosa*, M., also in Millstone Grit; *Dactylotheca plumosa*, Artis, M., and vars. *dentata* and *delicatula; Pecopteris Miltoni*, Artis, M.; *Pecopteris Volkmanni*, Sauveur, M., unique in Yorkshire; *Alethopteris lonchitica*, Schl., M. and Millstone Grit; *A. decurrens*, Artis, M.; *A. valida*, Boulay, M., unique; *Odontopteris britannica*, Gutbier, M.; *O. binervosa*, Achapohl, M.; *Neuropteris heterophylla*, Brong., M.; *N. tenuifolia*, Schl., M.; *N. rarinervis*, Bunbury, M.; *N. gigantea*, Sternb., M.; *N. obliqua*, Brong., M. (rare); *N. Scheuchzeri*, Hoffm., M. (rare); *N. osmundæ*, Artis, M.; *Rhacophyllum crispum*, Gutbier, and var. *lineare*, M.; *Spiropteris* sp.; *Megaphyton frondosum*, Artis, M. (rare).

LYCOPODIACEÆ.—*Lepidodendron dichotomum*, Sternb., M.; *L. ophiurus*, Brong., M.; *L. obovatum*, Sternb., M., L., and Millstone Grit; *L. aculeatum*, Sternb., M., L., and Millstone Grit; *L. Haidingeri*, Ett., M.; *L. Haidingeri*, Zeiller, M.; *L. Wortheni*, Lesq., M.; *Lepidophloios laricinus*, Sternb., M.; *L. acerosus*, L. and H., M.; *Halonia*, sp., the fruiting branches of *Lepidophloios*; *Lepidostrobus variabilis*, L. and H., M. and L.; *L. lanceolatus*, L. and H., M.; *L. ornatus*, Brong., M.; *L. anthemis*, König, M.; *Lepidostrobus Geinitzii*, Schimper, M. and L.; *Bothrodendron minutifolium*, Boulay, M.; *Lepidophyllum majus*, Brong., M.; *Sigillaria discophora*, König, M., L., and Millstone Grit; *S. mammillaris*, Brong., M., and var. *vulgaris*, M.; *S. scutellata*, Brong., M.; *S. Boblayi*, Brong., M.; *S. ovata*, Sauveur, M.; *S. deutschi*, Brong., M.; *S. tessellata*, Steinbauer, M. and Millstone Grit; *S. elegans*, Brong., M.; *Sigillariostrobus*, sp., M.; *Stigmaria ficoides*, Sternb., passim; *S. reticulata*, Göpp., M.

CORDAITEÆ.—*Cordaites principalis*, Germar, M. and L.; *Artisia transversa*, Artis, M. and Millstone Grit; *Cordaianthus pitcairniæ*, M.; *C. Volkmanni*, Ett., M.; *Cardiocarpus Gutbieri*, Geinitz, M.; *C. marginatus*, Artis, M.; *Trigonocarpus Parkinsoni*, Brong., M.; var. *bockschiana* and *amygdalæformis*, M.; *T. oblongus*, L. and H.; *L. Noeggerathii*, Sternb., M.; *T. ovatus*, L. and H., M.; *Polypterocarpus*, sp., M.; *Rhabdocarpus sulcatus*, Prestl., M.; *R. sulcatus*, Kidston, M.; *Carpolithus inflatus*, Lesq., M.; *C. bivalvis*, Göpp., M.; *Pinnularia prostrata*, Artis, passim.

GNETACEÆ.—*Gnetopsis*, sp., M.

In all cases but the ferns the names are given to *parts* of plants only, and it follows that one plant may have as many names as preserved parts.

[**495.**] **Kidston, R.**—On the Fossil Flora of the Potteries Coal-field.

Paper read to the Royal Society of Edinburgh, July 7, but not published in 1890.

[**496.**] **Spencer, J.**—The Common Fossil Plants of the Coal Measures.

Paper read to the Leeds Geologists' Association, May 15, but not published in 1890.

[**497.**] **Olliver, R. M.**—Fern Leaves and other Remarkable Fossil Plants from the Bradford Coal Measures.

Paper read to the Bradford Naturalists and Microscopists' Society on Sept. 22, but not published in 1890.

[**498.**] **Olliver, R. M.**—Forest Life in Bradford during the Carboniferous Period.

[**499.**] ——————Fruit and Foliage of Fossil Ferns from Bradford Coal Measures.

Papers read to the Bradford Scientific Association, but not published in 1890.

500. Seward, A. C.—Specific Variation in *Sigillariæ*.

Geol. Mag., Dec. 3, vol. vii., p. 213.

This consists of a brief account of the views of German writers on the groups of *Sigillariæ*, with brief notes on three specimens in German museums. There is no reference to anything British.

501. Seward, A. C.—*Tylodendron*, Weiss, and *Voltzia heterophylla* Brongniart.

Geol. Mag., Dec. 3, vol. vii., p. 218.

Notices that Dr. Potonié (in Jahrb. K. P. G. Landesanstalt, 1887) has referred the specimens figured by Williamson (Pal. Soc., *Stigmaria ficoides*, pl. 13, figs. 64, 65) to *Tylodendron* medullary cavities, and he has seen a specimen in the Strasburg Museum, which has similar small slits on the areolæ, and which is referred to *Voltzia heterophylla*.

[**502.**] **Phillips, W.**—The Affinities of *Pachytheca*.

Paper read to the Caradoc Field Club on Sept. 30, and reported in the local newspapers.

503. Walkden, R.—*Stigmaria ficoides* found in a Mine at Over Darwen, Lancashire.

Trans. Manch. Geol. Soc., vol. xx., p. 461.

This is a root, 16 ft. in length, elliptical in section, a [shrinkage] groove along the top 3—4 in. × 2—3 in., tapering to a point, in the bottom of a bed of underclay with gannister below.

504. Wethered, E.—On the Occurrence of Fossil Forms of the Genus *Chara* in the Middle Purbeck Strata of Lulworth, Dorset.

Proc. Cottswold Nat. Field Club, p. 101, with a plate of five figures.

These are seen in thin section. They may or may not be identical with those *named* by Forbes (but never described, and the types are lost). There are three varieties: one with large central cell, surrounded by 6 rather smaller ones, and

6 small ones in the exterior angles; another with very large central cell and 12 equal small ones; a third with a smaller central cell, 6 larger round it, and 6 minute ones in the angles. [He does not seem to have found any longitudinal sections, so that these might be either stems or carpogonia.]

[**505.**] **Somervail, A.**—Note on the Occurrence of a Fossil Fungus (*Hypoxylon concentricum*, Grev.) from the Submerged Forest of Torbay.

Paper read to the Torquay Natural History Society on Dec. 10, but not published in 1890.

[**506.**] **Carruthers, W.**—Presidential Address on the Distribution of British Plants both before and after the Glacial Period.

Read to the Linnæan Society on May 24, but not published in 1890.

MINERALOGY.

507. Hoskyns-Abrahall, J. L.—A Visit to the Calcite Quarry in Iceland.

Min. Mag., vol. ix., p. 179.

This quarry is on a slope which slants down at an angle of 40° towards the Reydharfjordhr on the east coast. The fiord is cut out of an immense plateau of Trachyte, 3,000—4,000 ft. high. The quarry is a cavity in the rock, 12 yards by 5 yards and 10 ft. high, now only *lined* with immense crystals. It has 5 ft. of water in the bottom, but this does not now form calcspar, but etches it or coats it with stilbite. The rock of the cave is a dolerite, veined and disintegrated. It is not now worked, the store already got being held for high prices, by Talinius, Stokholmsgade 16, Copenhagen K., but the working rights are now in the hands of the Icelandic Government.

508. Maden, H. G.—Bertrand's Idiocyclophanous spar-prism.

"Nature," vol. xlii., pp. 75, 99.

If a rhomb of Iceland spar be taken, and two planes rubbed down and polished in such a direction that they are parallel to the optic axis, and make an angle of 45° with one of the flatter faces, then, since the faces of the natural rhombohedron make an angle of nearly 45° with the optic axis, a beam of light falling perpendicularly on the first polished face will be reflected internally at the first natural

face, pass along the optic axis to the other, and be again reflected internally, and come out perpendicularly to the other polished face, and will show the pair of ring systems side by side, one set complementary to the other. On p. 99, he points out that if an hexagonal prism be taken, as it cleaves at 45° with the optic axis, a pair of the sides of the prism will do for the opposite worked surfaces, and the cleavage planes for the other pair.

[**509.**] **Trouton, F. T.**—A Co-efficient of Abrasion as an Absolute Measure of Hardness.

Paper read to the British Association on Sept. 10, but not published in 1890.

510. Claque, D.—A New Form of Goniometer.

Journal Liverpool Geological Association, vol. ix., p. 18, with a figure.

A graduated horizontal disc has a broad, flat needle, movable about its centre and pointed at both ends. From one arm ascends a vertical stem, leading to a universal joint with sliding pincers, by which the mineral may be set in any position. In measuring an angle, the edge of the crystal is placed so as to be vertical over the centre of the disc, and the needle is then moved horizontally about this pivot.

511. Johnstone, A.—Improvements in the Methods of Determining the Composition of Minerals by Blowpipe Analysis.

Trans. Geol. Soc. Edinburgh, vol. vi., p. 43.

This consists mainly of tables of the behaviour of acids and bases as tested in the various ordinary ways. He notes some special tests. 1. For mercury, if heated with fusion mixture in the closed tube it gives a metallic sublimate which, if wetted with HNO_3 and then by KI, turns red on warming. 2. Antimonious sublimates are turned orange by ammonium sulphide. 3. For tin, beads obtained by fluxes, pounding, and lixiviating, are heated with a drop or two of H Cl, add gold chloride, and the purple of Cassius is seen. To get colour flames from infusible substances, heat them first with solid ammonium fluoride.

512. Prior, G. T.—On Zinc Sulphide Replacing Stibnite and Orpiment; Analyses of Stephanite and Polybasite.

Min. Mag., vol. ix., p. 9.

(1) The yellow incrustation on stibnite from Felsöbanya is already known to consist of zinc sulphide, but it is not Wurzite, as supposed, the latter being less soluble in cold H Cl. One incrustation contained zinc in the ratio of 1·05 to the sulphur, which may be due to an oxide. The same incrustation has now been found on stibnite from Estremadura and from Siegen. That on other specimens is antimonious. A similar incrustation has also been found on

orpiment from Felsöbanya. (2) Stephanite from Copiapo yields Ag 68·65, Sb 15·22, and S 16·02, giving the formula $5Ag_2S, Sb_2S_3$, and is nearly pure. It shows the forms 001 (c), 201 (d), 101 (k), 313 (b), 111 (P). A specimen from Wheal Boys is contaminated by Pyrargyrite, and yields Ag 68·21, Sb 15·86, and S 15·95. It shows the forms 001 (c), 111 (P), 011 (β), 112 (h), 110 (o), 130 (λ), 100 (a), 731 (Γ), 201 (d), with hemimorphism and twinning. Another from Wheal Ludcott shows the forms 001 (c), 110 (o), 113 (m), 112 (h), 111 (P), 203 (t), 101 (k), 201 (d). (3) Polybasite from Santa Lucia Mine, Guenaxato, Mexico, yields on analysis Ag 68·39, Cu 5·13, Sb 10·64, As 0·50, S 15·43.

513. Miers, H. A.—The Hemimorphism of Stephanite: the Crystalline form of Kaolinite.

Min. Mag., vol. ix., p. 1.

He gives a diagrammatic figure of a combination from Wheal Boys, Endellion, and elsewhere, containing the forms 001 (c), 100 (a), 110 (o), 201 (d), and 111 (P), twinned upon the face 110. The hemimorphism is shown by the fact that the striæ on the upper part of the faces (o) run in one direction parallel to their intersections with those faces of the form 731 (Γ) that are situated at the lower end of the prism, which faces sometimes occur at that end only. The prism is also represented as twinned, with composition parallel to the basal plane, so that the striæ and faces produced by Γ are symmetrically situated, and in this case the faces form re-entering angles. It also shows the almost universal twin structure of Stephanite about the planes 110 (o). Upon some crystals the hemimorphism is shown by the striæ at the two ends of the prism being in different directions; at one end being inclined to the prism edge at 23° 21½′, and formed by the faces 731 (Γ) belonging to the zone ($\bar{1}14$), the others being inclined at 40° 46′, and formed by the faces 421 (ρ), belonging to the zone ($\bar{1}12$).

He gives a correction of the elements of Kaolinite as stated in vol. viii., p. 25. $\beta = 83° 11'$, $a:b:c = 0·5718:1:1·5997$. The angles $b\ m = 60° 17'$, $c\ m = 84° 5'$, $c\ n = 78° 8'$, $b\ n = 60° 44'$.

514. Hyland, J. S.—On the Mesolite (Galactite) of Kenbane Head, co. Antrim.

Proc. Roy. Dublin Soc. Vol. vi., N. S., pt. 8, p. 411.

In this cliff the decomposed basalt is seamed with veins of a white needle-like zeolite. This he has analysed. It gives:—

Silica	46·50
Alumina	27·55
Lime	2·59
Soda	13·28
Water	10·10
	100·02

Sp. gr. 2·26 This he considers to be a mixture of nine equivalents of Natrolite with two of Scolezite ,which is the proportion characteristic of Galactite from Bishopstown. He concludes with some general observations about zeolites, and about the temperature at which they begin to lose water; that which is combined with the silica being drawn off at a lower heat than that combined with the alumina. From the experiments of Carl Hirsch (Zurich, 1887) on the loss experienced by Natrolite and Scolezite on heating, he concludes that both water-groups of atoms must be combined with the aluminium in the former, and the third with the silicon in the latter.

515. Miers, H. A.—Sanguinite, a new mineral; and Krennerite.

Min. Mag. vol. ix., p. 182.

This is in the form of scales on the surface of Argentite from Chanarcillo. They have a bronze-red colour by transmitted light, and a lustre like earthy hæmatite, but differ from Gothite in being without striation, and remaining dark between crossed nicols. Qualitative tests, which are alone available, show it to be probably a sulpharsenite of silver. It is black by reflected light, and has a dark purplish brown streak, by which it is distinguished, as well as by its form, from Proustite. It is of the hexagonal system.

Krennerite is a rare telluride of gold from Nagyag, of which three crystals have been already measured. The following observations confirm these results. The forms observed are 010 (a), 001 (c), 110 (m), 101 (e), 212 (u), 111 (o), 232 (i), 011 (h), 021 (ρ), 100 (b); also six new forms 201 (d), 301 (q), 401 (s), 211 (t), 632 (v), 214 (w). The angles observed are ce 26° 50′, ch 28° 19′, cd 45° 20′, cq 56° 35′, cs 63° 48′, cρ 46°52′, ai 54° 11′, ao 64°21′, au 76° 27′, ev ? 29° 47′, am 43° 5′, ct 49° 4′, cv 59°52′, cw 15° 58′, eu 13° 33′, ch 23°56′, hu 29° 2′, ud 22° 44′, co 36° 27′. These lead to the axial ratios a : b : c = 1·0651 : 1 : 0·5388.

516. McMahon, C. A.—Notes on Bowenite, or Pseudo-jade from Afghanistan.

Min. Mag., vol. ix., p. 187.

The material in question is obtained from Bhera, in the Shahpur District of the Punjaub, where it is manufactured. It is derived from a mountain gorge leading to the Kabul river. Its hardness is 5, s.g. 2·59, and colour dark greenish-grey to pale sea-green. An analysis by **G. T. Prior** gives:—

Silica	44·73
Magnesia	42·64
Alumina	0·32
Ferrous oxide	0·33
Water	12·21
	100·23

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It is thus a very pure serpentine, and agrees closely with Bowenite in the above characters. Under the microscope it shows fibrous crystals, arranged parallel to three cleavages—two at right angles—indicating an original pyroxene. Some portions are micaceous, and are considered to be crystalline serpentine. There are also some feathery crystals, probably formed in the original olivine.

517. Hutchings, W. M.—" Note on the Occurrence of Willemite in a Slag."

Geol. Mag., Dec. 3, vol. vii., p. 31.

This Willemite, or silicate of zinc, is formed in a slag which contains no more than 12—15 per cent. of zinc oxide, produced in the smelting of lead dross in a small blast furnace. It occurs in slender acicular hexagonal crystals, with occasional rhombohedral ends, which have a high positive double refraction, and are pale yellow and dichroic. These crystals are found in cavities and also in the mass, which consists of the Fayalite variety of olivine. They were formed constantly for ten days; but in another run they were absent, the only difference of condition noticed being a greater percentage of lead (5 against 1½) in the latter case. This suggests that in rocks the presence of a small quantity of an easily vitrified ingredient may prevent other portions from crystallizing.

[**518.**] **Abbott, W. J. L.**—Some Optical Properties of Gems.

Paper read to the London Amateur Scientific Society on April 11, but not published in 1890.

[**519.**] **Miers, H. A.**—Note on Ullmannite.

Paper read to the Mineralogical Society on Nov. 11, but not published in 1890.

[**520.**] **Solly, R. H.**—Notes on Cassiterite.

Paper read to the Mineralogical Society on Nov. 11, but not published in 1890.

[**521.**] **Trechmann, C. O.**—Twins of Marcasite in Regular Disposition upon Cubes of Pyrites.

Paper read to the Mineralogical Society on Nov. 11, but not published in 1890.

[**522.**] **Fox, Howard.**—Picotite on Serpentine.

Paper read to the Royal Geological Society of Cornwall in November, but not published in 1890.

[**523.**] **Hardcastle, C. D.**—Agates.

Paper read to the Leeds Geologists' Association on Nov. 20, but not published in 1890.

[**524.**] **Hunt, A. R.**—Notes on some South Devon Quartzes.

Paper read to the Torquay Natural History Society on Feb. 12, but not published in 1890.

525. Sollas, W. J.—On the Occurrence of Zinnwaldite in the Granite of the Mourne Mountains.

Proc. Roy. Irish Academy, 3rd ser., vol. i., p. 379.

The author suspected lithium might be found in the micas of the geodes containing topaz. They have a remarkably perfect cleavage, give a crimson colour to the Bunsen flame, seen to be due in the spectroscope to Li α. The greatest amount of lithium is in the silvery white varieties. The flakes have a zonal structure parallel to 010, $\bar{1}11$, generally darker in the middle. The darker has sp. grav. 3·2, compared with 2·8 of the lighter. "Schlag" figures are obtained, the ray along the clinodiagonal section being in the plane of the optic axes. These diverge 44° 1′ in the darker, 52° 6′ in the lighter parts. These characters indicate that the mineral is Zinnwaldite, and not Lepidolite. This is its first discovery in Ireland. The zonal structure may be due to differences of material of formation or to action from without.

[**526.**] **O'Reilly, J. P.**—On the Occurrence of Idocrase in the County of Monaghan.

[**527.**] ————.—On the Occurrence of Serpentine at Bray Head.

Papers read to the Royal Irish Academy on April 28 and June 23, but not published in 1890.

[**528.**] **Penfield, S. L.**—Connellite from Cornwall.

American Journal of Science?

529. Semmons, W.—Some Recent Additions to British Mineralogy.

Trans. Liverpool Geol. Assoc., vol. x., p. 9.

This calls attention to the heart-shaped twins of calcite from Egremont, the association of calcite and cassiterite at St. Just, and the occurrence at St. Stephen's, Cornwall, of three forms of apatite, elsewhere found in separate localities.

530. Dudgeon, P.—Notes on the Minerals of Dumfries and Galloway.

Trans. of Dumfries and Galloway Nat. Hist. and Antiq. Soc., No. vi., p. 175.

Antimonite has been said to be found in Kinharvey Burn, but he has been unable to verify this; also zircon in the Criffel granite, but he can only find sphene. This is characteristic of this granite even in boulders, and still more so is allanite. Gadolinite also occurs here and at Ben Loyal, Sutherland. Gold is said to have been worked in this district, and there is gold in the alluvium, but in infinitesimal quantities. He gives the following list:—

DUMFRIESSHIRE:

Wanlockhead (including *Leadhills*): Anglesite, Arragonite, Asbolane (new record), Aurichalcite (new record), Barytes, Calamine, Calcite, Caledonite, Cerussite, Chalcedony, Chalcopyrite, Chalybite, Chessylite, Chlorite, Chrysocolla,

Dolomite, Erythrine, Galena, Gold, Greenockite, Hæmatite, Jamesonite, Jasper, Kupfernickel, Lanarkite, Leadhillite, Limnite, Linarite, Lydian Stone, Malachite, Melaconite, Mimelite, Minium, Mountain wood, Mountain leather, Plumbocalcite, Plumbonacrite, Psilomelane, Pyrites, Pyromorphite, Quartz, Smithsonite, Strontianite, Susannite, Vanadinite, Vauquelinite, Wad, Zinc-blende.

Westerkirk, Glendinning: Antimonite, Calcite, Cervantite, Pyrites, Valentinite, Zinc-blende. Also Cervantite after Antimonite, and Antimonite after Cervantite.

Canobie: Selenite, Coal. *Moffat, Hartfell*: Alum Shale, Selenite. *Sanquahar*: Calcite, Coal, Pyrites.

GALLOWAY.

Anworth, Lackintyre: Anglesite, Calamine, Calcite, Cerussite, Chalcopyrite, Chrysocolla, Galena, Malachite, Pitchy Copper Ore, Pyromorphite, Vanadinite ? Wulfenite.

Breitle, Craignair: Amethyst, Sphene. *Almorness Head*: Molybdenite. *Girthon, Pibble Mine*: Anglesite, Cerussite, Chessylite, Chrysocolla, Galena, Malachite, Pitchy Copper Ore, Pyromorphite, Smithsonite, Towanite, Tungstate of Lead ?

Kirkmarbrick, Monypool Burn: Annabergite, Asbolane, Cerussite, Dudgeonite, Erythrine, Galena, Kupfernickel, Pyromorphite. *Cairnsmore*: Chalcopyrite. *Creetown*: Epidote.

Minnigolf, Black Craig Mine: Calcite, Dolomite, Erythrine, Galena, Pyrites, Zinc-blende.

Newabbey, Criffel: Allanite, Amethyst, Gadolinite, Magnetite, Pyrrhotine ? Sphene. *Kinharvey*: Psilomelane, Cairngorm, Wad. *Kirkbean*: Calcite.

Berwick, Auchencairn: Chalcopyrite, Chessylite, Chrysocolla, Hæmatite, Malachite, Pyromorphite.

Troqueer, Kirkconnell: Barytes, Wad. *Craigbill*: Hæmatite, Sphene. *Lochanhead*: Epidote.

[**531.**] **Heddle, M. F.**—On New Localities for Zeolites.

Paper read to the Geological Society of Glasgow in April, and also to the London Mineralogical Society Jan. 14, but not published in 1890.

532. Smithe, F.—The Minerals of Gloucestershire. Observations on Celestite.

Proc. Cotteswold Nat. Field Club, vol. x., p. 71.

This gives an account of the general distribution of Celestite, and Baryto-celestite, the former occurring in Gloucestershire at Clifton, Aust, Yate, and Wickwar, the latter at Clifton.

533. Johnstone, A.—The Classification, Determination, Distribution, Origin, and Evolution of the Normal Micas.

Trans. Edinburgh Geol. Soc., vol. vi., p. 17.

This differs very little from his paper (Q.J.G.S., vol. xlv.,

p. 363) " On the Action of Pure Water, &c., on the . . . Mica Family." He makes hydrous and anhydrous micas primary divisions, thus obtaining 4 species, " the varieties " of which he mentions. Then follows the determination of micas. To determine the abundance of magnesia, he heats the mica with 3 or 4 times its weight of ammonium fluoride, dissolves in strong hot H Cl and adds NH_4Cl and NH_3 after boiling and filtering to remove alumina. The magnesia is tested for by ammonium phosphate. Iron he detects by fusing with nitre, moistening with nitric acid, after which potassium sulphocyanide gives a red colour. Biotite is the original igneous mica. By exposure to water it hydrates to hydrobiotite. This, by the action of CO_2, loses magnesia and becomes hydromuscovite, which may lose its water by heat and pressure [not here proved], and become muscovite.

[**534.**] **Lobley, J. L.**—On the Origin of Gold.

Paper read to the British Association on Sept. 10, but not published in 1890.

[**535.**] **Barlow, W.**—On Atom Grouping in Crystals.

Paper read to the British Association on Sept. 10, but not published in 1890.

536. Judd, J. W.—On the Relations between the Gliding Planes and the Solution Planes of Augite.

Min. Mag., vol. ix., p. 192.

Augites exhibiting a lamellar structure parallel to the basal plane, are extremely common in Ardnamurchan, but they rarely, if ever, exhibit the simple twinning parallel to the orthopinacoid. Augite is capable of lamellar twinning parallel either to the basal plane or to the orthopinacoid. If the former are produced, chemical action results in a laminated augite; if the latter, the result is an ordinary diallage. This is analogous to the albite and pericline twinning in plagioclase felspar. He has already shown in calcite that, when gliding planes are formed, they become solution planes, in preference to the normal solution planes, and by this means explains the relation between lamellar augite and diallage. In augite, the normal solution plane is the orthopinacoid. If chemical action alone takes place at great depths, this is first attacked, and diallage is the result. The next solution plane is the clinopinacoid, and the last the basal plane. The development of all three produces pseudo-hypersthene; but if, previously to the commencement of chemical action, lamellar twinning parallel to the basal plane has been set up by pressure, then this becomes the first solution plane, and the lamellar augite is produced. These structures take place equally in augites of various compositions, and are not, therefore, dependent on composition. He objects to the use of the term " cleavage " for planes developed by mechanical

or chemical action, but would keep it for the planes of least cohesion [but the contents of this very paper seem to show that these are interchangeable, all being original constitution planes in the structure of the crystal, one or other of which is most easily *developed* by certain means].

PETROLOGY.

METEORITES.

537. Fletcher, L.—The Meteoric Iron of Tucson.
Min. Mag., vol. ix., p. 16.

The history of the discovery is discussed, and it is concluded that both the masses are from one source, fragments of each having been polished and showing a similar structure, in the absence of Widmanstätten figures and the inclusion of numerous crystalline grains. The largest is ring-like, and both come from a pass called Los Muchachos, between Tucson and Tubac, where they fell some centuries ago. The analyses show that they are composed of about 90 per cent. of Nickel Iron, of composition Iron 89·89, Nickel 9·58, Cobalt 0·49, Copper 0·04; about 9 per cent. of Olivine; of composition Ferrous Oxide 24·09, Magnesia 27·37, Lime 8·67, Soda 2·15, Potash 1·26, and Silica 36·48, with small quantities of Shreibersite and Chromite.

538. Fletcher, L.—On the Mexican Meteorites, with especial regard to the Supposed Occurrence of Widespread Meteoritic Showers.
Min. Mag., vol. ix., p. 91.

The idea that a single meteoric mass could spread over a wide area on entering the terrestrial atmosphere, by breaking up and scattering, has depended on three instances of their supposed wide distribution. One of these—that of the Desert of Atacama, the writer has already shown, gives no decisive evidence to this effect; the second, in Africa, depends only on the hearsay evidence of a single individual, and the writer now proceeds to discuss the case of Mexico. With regard to this, the general opinion is that masses of a single meteor may be distributed over thousands of square miles, perhaps by an enormous iron meteorite passing over, say, the entire breadth of the United States, and dropping fragments on its road. The writer thinks this is an unwar-

ranted, if not false, conclusion, and that meteors are not really more abundant in Mexico than elsewhere. Since 1804, only seven have actually been observed, which is fewer than in the British Isles [he does not consider the difference of population to observe]. Only one of these is iron, and masses have only been found in 9 States out of 18, and their distribution in Northern Mexico has never been adequately ascertained. The air of the country, being dry, is very favourable for the preservation of iron masses, but does not prevent the stony ones disintegrating. The date of some of the masses is known, indeed, to go back to before the conquest by the Spaniards, and some of these have certainly been transported for long distances, an act which the ancient Mexicans were quite capable of doing; and in many cases they reverenced them as having descended from the gods. He then gives historical details of the various finds and records, and concludes that several have been named twice, without their identity being recognised. In each of the States of Zacatecas, Oaxaca, Guerrero, and Sinaloa only one mass has been found; each probably independent. In San Luis, Potosi, two, but one has probably been brought from a distance. In Durango, four or five localities are known, but the masses, as far as examined, are distinct. In Mexico, there has undoubtedly been a large shower, of limited dispersion, in the valley of Toluca. The other three have been imperfectly examined. From Coahuila, many masses have been got, but probably originally from a small area. The two Nuevo Leon masses may have been transported. In Chihuahua, three or four areas are represented. They have been incompletely examined, but the maximum original dispersion could not have been more than 66 miles.

[**539.**] **Haughton, S.**—Two Meteoric Stones that fell in Winnabayo, co. Iowa, on 2nd May, 1890.

Paper read to the Royal Irish Academy, Nov. 10, but not published in 1890.

540. Deane, W. D. H.—Meteorites.

Proc. Liverpool Geol. Assoc., vol. ix., p. 22.

A general paper.

IGNEOUS ROCKS.

541. Harker, A.—Notes on North of England Rocks, II.
"The Naturalist," p. 237.

The rocks described are: VII. Hypersthene quartz gabbro of Carrock Fell. The dominant pyroxene is diallage; but in some, hypersthene is quite as abundant, in others it is absent. The felspar is labrador-bytownite. The hypersthene is usually changed to "bastite," and the diallage to hornblende; quartz

is about 20 per cent. VIII. Granophyre of Carrock Fell. This is micropegmatitic with felspar phenocrysts ["insets"] often in optical continuity, and passes by fineness of structure into spherulitic. He has a slice showing a passage into No. VII., but does not explain how the passage is effected, only the other type is seen "elsewhere in the same slice." IX. Spherulitic Quartz-porphyry dyke at Greenside's Mine, Helvellyn. The spherulites are small and distinct, sometimes free, sometimes round the insets. There are also long crystallites parallel to their edges. X. Microgranite of St. John's Vale. The insets are plagioclase, the ground mass minute quartz and felspar, the former first formed, the latter rather decomposed and probably a soda-lime variety. XI. Granite of Eskdale and Wastdale. The felspars are arranged as in "Micro-perthite." XII. Diabase or dolerite of Castle Head, Keswick. The augites are well formed, twinned, and almost porphyritic. The ground mass is of felspar and altered augite, with serpentine veins.

542. Teall, J. J. H.—The Amygdaloids of the Tynemouth Dyke.

Rep. Brit. Ass. for 1889, p. 572.

Published *in extenso* in the Geol. Mag. for Nov., 1889. In this rock there are spherical patches, originally vesicular cavities, which have been filled with the liquid interstitial matter which has oozed into them when the gas escaped or was absorbed. "This is proved by the occurrence of cavities which have been only partially filled up." [He does not explain how liquid interstitial matter can ooze through the solidified portions of the same substance.] The porphyritic constituents are compound, the inner part being a granular aggregate of an anorthite felspar, the outer a fresh zone of idiomorphic felspar of later origin. The interstitial matter is arranged in an *intersertal* manner.

543. Rutley, F.—"The Geology of the Country around Ingleborough."

Memoirs Geol. Survey, p. 16. Intrusive rocks.

1. Mica trap in Thornton Beck. The rock consists of magnesian mica, kaolinized felspar, and pseudomorphs. It is too decomposed to distinguish the felspar, but the mica is conspicuous.

2. Kersantite Dyke, in road south-east of Skirwith. A crystalline aggregate of felspar and magnesian mica. Some of the felspar is triclinic, and apatite is present.

3. Kersantite Dyke, in Ingleton Beck. A similar rock, the felspar stained flesh red.

[**544.**] **Tate, Thos.**—Note on Phillips' Dyke, Ingleton.
Paper read to the British Association on Sept. 8, but not published in 1890.

[**545.**] **Tate, Thos.**—On the so-called Ingleton Granite.

Paper read to the British Association on Sept. 4, but not published in 1890.

[**546.**] **Hatch, F. H.**—On some West Yorkshire Mica Trap Dykes.

Paper read to the British Association on Sept. 8, but not published in 1890.

547. Tate, T.—Yorkshire Petrology, part ii. The Lamprophyres.

Proc. Yorks. Geol. and Polyt. Soc., new series, vol. xi., p. 311, pl. xiv. and xv.

This deals with a series of five dykes near the bed of the Dee, at the foot of Helmsknott, near Dent, intrusive into Coniston Limestone and shale. The constituents of the uppermost are mica, hornblende, and felspar. The brown mica is of two generations, the first corroded, the younger with frayed edges. The felspars are either small and uniform, or porphyritically or glomero-porphyritically developed. No twin lamellation is seen, but the crystals are cracked and kaolinized, and then look like olivine pseudomorphs. There are also crystals of sphene and hornblende-pseudomorphs. The lowest dyke shows densely massed brown mica in a devitrified magma, with fan-like groups of felspar microlites, with finer acicular microlites in the interspaces. These radiate from the mica plates. The mica is of two generations. There is also some chloritoid mineral and titaniferous magnetite, pyrites, &c.

548. George, J. E.—Notes on some Manx Lavas.

Proc. Liverpool Geol. Assoc., vol. ix., p. 41, with four illustrations.

This deals with the amygdaloidal lavas of Scarlettstack. They show fluidal structure, and contain magnetite and plagioclase, but no included crystals. The vesicles are lined with silica [in the figure "serpentine" is written] and filled with calcite, but occasionally it is *vice versâ*. Agglomerates are associated with this. He suggests that the sheets of lava "in rolling along" in the carboniferous sea "would imprison numberless bubbles of the surrounding water," and so produce the vesicles [!].

549. Clark, Thos.—Mineralogy of the Rocks lying between the Black Head and Porthallow, N.E. of the Lizard District.

Journ. Royal Inst. Cornwall, vol. x., p. 176, plates A, B, C.

This is a supplement to a former paper on "Basal Wrecks and Remnants of Extinct Volcanoes on the S.W. coast of Cornwall," published in the previous number of the same journal, and consists of explanations of twelve coloured

figures of rock sections, part of 24 which are in the Truro Museum. These figures are very diagrammatic, but show clearly the facts which the writer expresses. 1. is from a horizontal sheet of lherzolite from the south of Coverack, showing large crystals of enstatite and olivine, both being converted into serpentine. 10. is the same rock, the change being further advanced. 2. is from the lower sheet of overlying gabbro, and shows two masses of banded felspar and one of hornblende, said to be after augite. 3. is from gabbro above Coverack Valley, and is extraordinarily fresh, composed of equal parts of augite, banded felspar, and olivine. 4. shows part of the same sheet from the N.E. brow, where the olivine and felspar are separated by an irregular band of hornblende, coloured dull green, and with fine parallel lines. This is anthophyllite or an acicular variety of hornblende. 5. shows the decomposition in a more advanced stage, the olivine and felspar being left as rounded islands in a sea of anthophyllite. 6. from near at hand, shows that this has only taken place between the olivine and felspar, the augite being untouched in its contact with either. 7. from Dean Point, shows a vase-like outgrowth of augite half surrounding an olivine crystal. Where the latter is free, it has a halo of hornblende, but where protected by the augite it is unaltered, showing the preservative effect of augite. At Godrevey point, he has found altered slates at the base, by which means he estimates the thickness of the basic rocks at 600 ft. 8. is from a quarry at the head of Porthoustock Creek, and shows banded felspar in broken crystals in the midst of a matrix of radiated hornblende. 9. from Porthallow, shows serpentine derived from olivine, and enstatite in process of changing. 11. from Shepherd's Quarry, Porthallow, shows malacolite changing into dark green hornblende, which occurs in irregular hollowed patches [with an eroded appearance]. 12. from Porthallow, shows large anthophyllite crystals. The banded and foliated appearance of the hornblendic schists of this locality he attributes "to the varying composition of the materials supplied to the crater," like the banded ashes of Pompeii. This is the case, he thinks, because the freshest minerals are at the top, which the metamorphism from below has been the last to touch.

550. Fox, H.—On the Junction of Hornblende Schist and Serpentine in the Ogo Dour District, and on the Occurrence of some Bands of Potstone North of Pol Cornick.

Trans. Roy. Geol. Soc. Cornwall, vol. xi., p. 213.

The junction is not a definite one, but the rocks alternate for a time. One of the alternations in a cave is Prof. Bonney's junction; about 80 yards S.W. is a promontory at Pol Cornick

(drawn on the 25 inch scale), showing serpentine and hornblende schist alternating, crossed by two small "trap" dykes, and by a band of porphyritic diorite; and opposite the island of schist, part of it has potstone in it, lead coloured when fresh.

551. Teall, J. J. H.—Notes on some Rocks from North Pol Cornick.

Trans. Royal Soc. Cornwall, vol. xi., p. 217.

Two of the rocks are carefully described, and analyses by **Player** are given :—

	No. 4.	No. 2.
Carbonic acid	·9	2·2
Further loss on calcination	2·6	5·1
Silica	47·1	54·1
Titanic acid	·2	—
Alumina	19·2	2·4
Ferric oxide	·5	·7
Ferrous oxide	3·1	4·8
Lime	16·1	3·5
Magnesia	8·2	26·3
Soda	2·	—
Potash	·4	·2
	100·3	99·3

No. 4 is a dark band between two light bands, in the latter is malacolite, in the former hornblende, felspar, and sphene, and pseudomorphs after porphyritic felspars, forming "eyes." No. 2 is a potstone chiefly composed of scaly talc.

552. Somervail, A.—On the Schists of the Lizard District.

Geol. Mag., Dec. 3, vol. vii., p. 161.

This paper contains little but a mass of opinions, which may or may not be sound, but no definite facts which could be tested are given in support of them. He denies there are any intrusive veins, and quotes the case of the shore at Polpeor, in which Gen. McMahon and Prof. Bonney both see an intrusive dyke, but which Mr. Teall describes as "bosses and lenticles of greenstone, in association with green actinolitic schists"; a description which scarcely implies that they are intrusive.

553. Rutley, F.—On a Specimen of Banded Serpentine from the Lizard, Cornwall.

Trans. Roy. Geol. Soc. Cornwall, vol. xi., p. 239.

It is dark green, with bands of paler green, and red bands ⅛ in. broad. It is cataclastic, with minute fragments of olivine, anorthite and hornblende of a brown tint; these are imbedded in a serpentine ground-mass, some parts with mesh structure from olivine, some with grid structure from hornblende. It is produced by the mechanical deformation of anorthite gabbro.

[**554.**] **Fox, H.**—On the Micaceous Schists of the Penolven District.

[**555.**] ————The Carvuga Boulder.

Papers read to the Royal Geological Society of Cornwall in November, but not published in 1890.

556. Hunt, A. R.—The Age of the Granites of Dartmoor and the English Channel.

Rep. Brit. Ass. for 1889, p. 569, published in Trans. Devon Ass., vol. xxi.

Tourmaline is absent in rocks dredged in the Channel, but hornblende is abundant, and the reverse is the case with the Dartmoor granite. The inclusions in the quartz of the former are water; in that of the latter brine. The bubbles in the minerals of the former are more active, and the structure of the Channel rocks is often gneissose, and there is no evidence of veins in them. The Channel rocks have been considered Archæan, but the Dartmoor granites to be post-Carboniferous. He seems to think, however, that both are at least pre-Devonian [but gives no definite reasons], but they have undergone different kinds of changes.

[**557.**] **Hunt, A. R.**—On the Origin of the Saline Inclusions in the Crystalline Rocks of Dartmoor.

Paper read to the British Association on Sept. 8, but not published in 1890.

558. Lapparent, A. de.—Comptes Rendus, vol. cxi., p. 542.

The pyromerides of Jersey he formerly thought were Permian, as they overlay the schists, and were only overlain by supposed Trias rock, and they are also very like Permian Volcanic rocks of the Vosges and Morvan. But now he has learnt that earlier felstones are possible, and, on examining the district, he finds that these felstones are part and parcel of the schists, and the separation of the two is not easy. The overlying grits are also now known to be the purple Cambrians.

[**559.**] **Lapparent, A. de.**—On the Porphyritic Rocks of the Isle of Jersey.

Paper read to the Geological Society on Nov. 12, but not published in 1890. Abstract sent to Fellows.

560. Judd, J. W.—The Propylites of the Western Isles of Scotland and their Relation to the Andesites and Diorites of the District.

Q.J.G.S., vol. xlvi., p. 341, plates 14, 15.

Propylites are a "pathological variety" of andesite; that is, the latter rocks have undergone internal changes to produce the former. These propylites are generally dark coloured and dull, and have a specific gravity of 2·4—2·9, while the neighbouring gabbros, &c., have it about 3. Some are

scoriaceous, and there are associated ashes. They form the group he previously called by the name "felstone." They weather white, by the iron first becoming magnetite and then being dissolved out by the peaty waters. They are characterised also by the presence of abundant pyrites and other sulphides, and aggregates of epidote occupy the original cavities. These characters, and their passing into holocrystalline masses, render them analogous to the "Propylites" of the Western Territories.

They may be divided into two groups by their specific gravities being in one group 2·4 to 2·7, in the other 2·7 to 2·9. The greater the crystallization the higher is the specific gravity; the greater the alteration, the lower. The more acid, lighter types are more hornblendic; the more basic and heavier are more pyroxenic. Analyses of the two types are as follows:—

	Hornblendic Andesite.	Pyroxenic Propylite.
Silica	62·89	58·07
Alumina	14·84	17·62
Ferric oxide	9·20	4·97
Ferrous oxide	—	3·09
Lime	3·61	5·23
Magnesia	0·37	1·46
Soda..	4·01	3·31
Potash	2·91	2·15
Loss on ignition	1·41	4·15
	99·24	100·05

Those which had glass have now been devitrified, the glassy matrix being the most altered part. The felspars are mostly plagioclastic, and have become opaque, and are often replaced by minerals of the epidote group. The ferro-magnesian constituents are mostly replaced by minerals of the chlorite group, and these again by epidotes. The pyroxenes are mostly augite, but may be enstatite. The hornblendes are now tufted forms surrounded by grains of magnetite. Biotite, original and secondary, is often present. Titanoferrite is also indicated by its alteration products, especially by pyrites. These rocks are the earliest erupted in the district, being intruded upon by the granites and gabbros. They cannot be separated into effusive, plutonic, and dyke rocks. They occur as thick and bulky lava currents, as cupolas, and as laccolites.

The rocks from which these propylites have been derived are classified thus:—*a*. Amphibole- and mica-andesites; *b*. Pyroxene-andesites. The former group is seen best preserved at a distance from the eruptive centres. It consists of—1. Hornblende andesites, having a microlitic felt of felspar needles, with scattered groups of green hornblende crystals,

which originally had a resorption halo, now changed to chlorite and magnetite. None are quite glassy, but several are highly crystalline and contain secondary quartz. 2. Hornblende-mica-andesites. These are pale grey and fissile, and occasionally contain enstatite. Some show gas cavities, now filled with glass. 3. Mica-andesites. These contain original mica, but pass into hornblende andesites, and the mica tends to increase by secondary additions. 4. Diorites, passing through granophyric varieties to the hornblende-andesites. 5. Quartz diorites. In the second group the phenocrysts ["insets"] are zoned labradorites, pseudo-diallagic augite, and enstatite. The ground mass has lath-shaped oligoclase, and granules of augite and magnetite. They may be divided into two groups. 1. The Vitrophyric or more glassy forms, though the crystals, porphyritic or otherwise, may be abundant, the glass has trichites. The specific gravity is 2·64, or, when the rock is minutely spherulitic, 2·49. 2. The Trachytoid, with a base of meshes of oligoclase, anorthoclase, and granular augite, with very little glass. When with a conchoidal fracture and semi-vitreous appearance, they constitute the *Stikkisholmur* type, often with large scattered crystals of plagioclase. When with augite crystals, also showing lamellar twinning, with schillerization, they form the so-called Diallage-andesites. When with large labradorite crystals, they are Labradorite-andesites, which sometimes have glassy patches. A mean analysis of this glass, by **S. Parish** and **H. J. Taylor**, gives—

Silica	61·80
Alumina	14·91
Ferric oxide	8·27
Lime	3·33
Magnesia	0·27
Soda	6·50
Potash	5·19
Loss	0·87
	101·14

The glass has incipient spherulites. There are also augite-diorites and quartz augite-diorites. All these differ from the basalts by the absence of olivine and of any ophitic structure.

The cause of alteration is 1. "solfataric action," *i.e.*, by steam and various acid gases, which destroy all the original constituents, and develop lime-iron and lime epidotes, chlorite and magnetite, and tend to disintegrate the rocks. 2. Contact metamorphism, which breaks up the ferro-magnesian constituents into granular aggregates of pyroxene, magnetite, and biotite, and causes the rock to harden.

The newest lavas are the augite andesites, or Tholeites, of

Eigg and Ben Hiant. In the latter locality they overlie agglomerates resting on the plateau basalts. The minerals in all of them are the same, viz., anorthite or labradorite, with zonal structure; brown and green augite, magnetite and brown glass, with spherulitic and perlitic structure. The different varieties depend on the relative proportions of these. They are :—1. Typical pyroxene andesites, with a microlitic felt of felspar and augite, and plagioclase crystals, augite and enstatite, with vesicular cavities in the small amount of glass. 2. The same, without porphyritic crystals. 3. Glassy andesites, with few crystals. 4. Tholeites, with little glass, and showing "intersertal" structure with skeleton magnetite. 5. Crystalline rocks, with "ophitic" and "granulitic" structure. 6. Varieties with felspar almost alone, and others with pyroxene almost alone.

Analyses are given of :—I. A tholeite, with little glass. II. Glassy andesite from Ben Haint. III. Glassy andesite from the Sgurr of Eigg.

	I.	II.	III.
Silica	52·68	66·62	65·81
Alumina	12 66	14·02	14·01
Ferric oxide ..	17·34	5·73	4·43
Lime	11·45	2·74	2·01
Magnesia	0·93	0·33	0.89
Soda	2·49	6·93	4·15
Potash	1·91	1·51	6·08
Loss	0·70	2·83	2·70
	100·16	100·71	100·08

There is a tendency in these rocks for the glassy parts to aggregate into patches; and the porphyritic masses are composed of plutonically arranged crystals.

561, Kendall, P. F.—The Geology of Mull.

Journal Liverpool Geological Association, vol. ix., p. 9.

This gives a short account of the volcano of Mull. He does not agree with Starkie Gardner that the acid eruptions belong to the granite intrusions of the Ross of Mull, as the rocks are really very different. The age of the granite cannot be pre-Cretaceous, as blocks of chalk as well as other rocks, including slate, are found in the associated agglomerates. He inclines to the "cone and crater" origin, rather than the "fissure eruption," because the dykes are radial, and not parallel, and because he has seen on Beinn Chreagach great intrusions of gabbro, which must have formed basalt on the surface. He notes that some of the dykes have their central portion vesicular.

[**562.**] **Wilson, J. E.**—Volcanoes of the Inner Hebrides.

Paper read to the Bradford Scientific Association, but not published in 1890.

[**563.**] **Young, J.**—On a specimen of Pendolite—a Highly Basic Igneous Rock—from Mugdock Tunnel, Milngavie, Dumbartonshire.

Paper read to the Geological Society of Glasgow on Nov. 13, but not published in 1890.

[**564.**] **Young, J., and Glen, D. C.**—Remarks upon the Tachylite found intrusive at Whiteinch.

Paper read to the Geological Society of Glasgow on Jan. 9, but not published in 1890.

565. Nolan, J., and Hyland, J. S.—Explanatory Memoir of Inishowen, County Donegal.

Memoirs Geol. Survey, chapter vi., and Appendix A.

The first of these authors describes the distribution of the igneous rocks, the second gives their petrographical characters.

1. *Granites.*—One type occurs at Dunaff Head. This is an amphibole granitite. The felspars show zonal structure, and in the biotite chloritized lamellæ are seen. Sphene is present, and there are pseudo-inclusions richer in hornblende and biotite, and also one true inclusion, which is now a biotite hornblende schist. "Had the rock been originally a hornblende rock, the corrosive action of the fluid granite would have altered the hornblende into pyroxene." It was originally a plagioclase pyroxene rock, altered by contact. There are no signs of mechanical deformation in this granite. Another type occurs at Ardmalin. This is coarser, has a pink orthoclase, and very varying proportions of green mica, the quartz is milky from its numerous liquid inclusions. It has been mechanically deformed and the quartz and felspar granulated, sometimes round less altered masses. The mica contains rutile in the form of sagenite, and there is no hornblende. A dolerite dyke has caused the rock to melt in contact, and it has re-crystallized micropegmatitically, the dolerite itself being changed and re-crystallized by absorption of the granitic material.

2. *Pegmatite* has been observed on the W.S.W. cliff along Dunaff Head. It is micropegmatite for the most part, the quartz being elongated in the direction of the prism face, causing a pseudo-microclinic structure.

3. *Quartz Diorite.*—At the same locality is found the only true diorite with original hornblende. It is dark in colour, and contains two varieties of hornblende, differing in pleochroism, which twin upon the orthopinacoid (100). The quartz is interstitial, and there is a little orthoclase and biotite, and the plagioclase is kaolinized.

4. *Lamprophyres (Camptonites).*—These occur as dykes in the schists three miles south-east of Dunree Head. They resemble grey fine-grained granite. The hornblende tends to

be porphyritic, and shows lamellar twinning. Plagioclase and orthoclase are present, one or other being predominant in different dykes. The quartz has the habit of that in granite, but is less frequent. There is no mica, but green chloritic patches may indicate its former presence. The lamprophyres with hornblende dominant are called Camptonites. "There is little or no mineralogical or textural difference between camptonite and diorite; their difference consists rather in their mode of occurrence" [that is, the same rock is called by different names, according as it occurs in a dyke or massive?]. Such dykes have not before been found amongst the schists of Ireland.

5. *Dolerites* are rare, but occur at Curdonagh, Dunaff Head, and Keeloges Bridge. The augite is ophitic, and changes at the edges to hornblende by chemical agencies, the felspars being unbroken. Near the faults at Keeloges Bridge the massive dolerite has been converted into hornblende schist, the hornblende winding in and out amongst the felspathic material, which is granulated, and the new product is a soda felspar. At the actual fault line it becomes finally a chlorite schist.

6. *Epidiorites* are the prevailing type of igneous rock here. They consist essentially of fibrous, needle-like, light green hornblende, and a plagioclastic felspar—the former most abundant. They have been produced from dolerites by regional metamorphism, and at Patrick O'Donnell's Bridge, south of Minteagh's Lough, may be seen passing into hornblende schist. The hornblende is uralite where derived from augite, but there are secondary enlargements around this whose pleochroism indicates actinolite. The uralite retains the original augite twinning, and the felspars have been reconstructed. Secondary mica is found in patches in the quartz-felspar mosaic produced by the alteration.

7. *Basalts.*—On the shore, west of Malin Pier, is a subporphyritic dyke, whose [insets] are green earth, pseudomorphic after augite; olivine was once present, but its place is taken by calcite, which has retained the original form and vitreous enclosures; others are at times vesicular.

8. *Biotite Schists*, composed of biotite, unstriated felspar, and quartz, occur north of Minteagh's, in a dyke-like protrusion, but the igneous origin cannot be definitely asserted; the mica appears to be primary.

9. *Actinolite Schists* occur at Castle Cross Waterfall.

10. *Hornblende Schists* and *Amphibolites* are altered dykes. They are called the former when foliated. In the centre, at Ineuran Bay, the rock is fine-grained, and becomes coarser and foliated; at the edges, where caught up in the granite, it is entirely reconstructed, like the altered dolerite above,

Near Malin Tower, it is actinolitic and micaceous, containing garnets, and includes patches of foliated granite.

11. *Quartzites* are usually felspathic, and east of Malin Tower become silvery schists. The materials here have been almost entirely reconstructed, but signs of the original clastic structure are not quite lost, and garnets and mica have been formed.

12. *Grits (with Phyllites)*, east of Curdonagh, show evidence of intense lateral compression, a quartz mosaic having been formed with quartz-mica phyllite bands, and even the pebbles have been granulated.

566. Hyland, J. S.—On some Epidiorites of North-West Ireland.

Geol. Mag., Dec. 3, vol. vii., p. 205.

This is an extract from his description of Sheet 17 of the Map of Geol. Survey of Ireland. The rocks described are intrusive sheets and dykes in quartzites and mica schists; they are not markedly foliated. The rocks were originally dolerites, but the pyroxene is altered into uralitic hornblende, retaining the original ophitic structure of the pyroxene, which may be pulled out and form an actinolite. There is also biotite, epidote, and zoisite. The felspar sometimes almost disappears, or it may be granulated. The original felspar is determined from some few well developed sections, which, on the M. face give an extinction of $-30°$, and which show an albitic lamellation. It is said to be labradorite (An_3Ab_1). The secondary felspar produced is determined by separation of the mineral of 2·645, sp. grav., by Sonstadt's solution, and analyzing it, its composition corresponds to $An_1\ Ab_{3·3}$. The lime set free has aided in the formation of epidote and zoisite. [It is not, however, stated where the soda comes from.]

567. Hyland, J. S.—On some Epidiorites of North-West Ireland.

Proc. Roy. Dublin Soc., vol. vi., N. S., pt. viii., p. 405.

These have already been described in the Memoir to sheet 17 of the Geol. Survey. They occur at Raphoe and Convoy in co. Donegal, and also in co. Londonderry. They were originally dolerites, the pyroxene has become a uralite in ophitic patches. When it is drawn out into lenticles, it becomes actinolitic. Biotite is also present with epidote, zoisite, and secondary quartz. The felspar is very variable, but is always less than the hornblende, and sometimes is *nil*. It becomes granulated, and, being originally labradorite, has become albitic; an analysis of the separated material gives percentages equivalent to orthoclase 2·11, albite 71·49, and anorthite 22·31; hence the mineral may be called an oligoclase.

568. Hyland, J. S.—On some Spherulitic Rocks from co. Down.

Proc. Royal Dublin Society, vol. vi., N. S., pt. viii., p. 420.

The principal one occurs near Newcastle, in a dyke near the Slieve Donald granite. It contains [insets] of felspar and quartz, and the spherulitic structure sometimes surrounds these, sometimes is independent. The black cross is not parallel to the vibration planes of the nicol, and may reduce to two dark spots on rotating; they are surrounded by a colourless ring. These are pseudo-spherulites, composed of an intergrowth of felspar and quartz. In the midst of a microperthite crystal is an hexagonal, nearly isotropic, mineral, which may be tridymite; if so, it is the second occurrence in Ireland. The mean analysis of the rock gives:—

Silica	70·07
Alumina	13·86
Ferric oxide	1·89
Ferrous oxide	·52
Lime	1·44
Magnesia	·70
Potash	6·90
Soda	3·55
Water	1·07
	100·00

Another spherulite is found in a felsite dyke at Leitrim River, Hilltown, and a third in the central dyke of Slieve Bearnagh. It is probable that these rocks are devitrified, but there is no direct evidence for their being originally vitreous beyond their present petrosiliceous character. He wishes to call them "spherulitic felsite porphyry," "but the employment of such a name would imply something as to their age."

As they may be Tertiary, he calls them "Spherulitic quartz trachyte" [seeing they are dykes, *felsite* is obviously more appropriate, and nomenclature by age may now be considered an obsolete tradition].

569. Hatch, F. H.—On the Lower Silurian Felsites of the S.E. of Ireland.

Rep. Brit. Ass. for 1889, p. 568.

Published *in extenso* in the Geol. Mag. for Dec., 1889. They consist of:—1. Potash felsites. 2. Potash-soda felsites. 3. Soda felsites; and there is very little lime. The first have no [insets]; the other two have, and perhaps their difference in composition may depend on differences of proportion between these and the base. Their modern representatives are liparites, and some may have originally been obsidians.

571. McMahon.—Notes on the Culm Measures at Bude, N. Cornwall.

Geol. Mag., Dec. 3, vol. vii., p. 106.

These Culm Measures are very much contorted and broken. A diagram of the rocks at Efford ditch shows a sigmoid fold at the top, which has slid over a mass of broken strata. The minerals of which these rocks are composed are such as might be obtained from a granitic area, but there are no fragments of slate or limestone. An analysis is given by **A. W. Stokes**:—

Silica	73·20
Alumina	11·20
Iron oxide	8·40
Magnesia	1·44
Soda, &c.	5·26
Water	·50
	100·00

The main object of the paper is to show that these rocks, though much folded and broken, are not in the least metamorphosed, and to throw doubt on the power of pressure alone to set up molecular activity. [That rocks can be contorted without being metamorphosed is already well known, and these Bude rocks form only another example.] He quotes Hallock's experiments, that under one set of conditions no change is brought about by pressure [but these do not invalidate Spring's, which show that, under other conditions, change does take place].

572. Hutchings, W. M. (Geol. Mag., Dec. 3, vol. vii., p. 188), replies to McMahon's paper that the Bude rocks have undergone a micrometamorphosis, minute crystals of fresh rutile and tourmaline being seen in excessively thin slices. [This, however, is a very different thing from a recrystallization of the whole rock.]

573. Harker, A. (Geol. Mag., Dec. 3, vol. vii., p. 189), explains how it is that rocks may be contorted without metamorphism, and *vice versâ*. All strains may be resolved into—(1) a uniform compression, (2) certain shears, the amount of each depending on conditions. The metamorphism is produced by the energy set free by the rocks yielding to these stresses—less what escapes by conduction. Thus, if rocks are situated at no great depth, and are subjected to a strong lateral thrust, there may be much contortion but little metamorphosing energy to spare. If they are at a great depth, and thereby softer, the energy set free may be greater, the loss less, and the metamorphic effect more noticeable. Absence of metamorphism, therefore, means difference of condition.

574. McMahon.—The Culm Measures at Bute, North Cornwall.

Geol. Mag., Dec. 3, vol. vii., p. 222.

The author replies to the above criticisms—in the first place, that unworn tourmalines and rutiles are found in Tertiary clays and sands, and are no proof of metamorphism. With regard to Mr. Harker's note, he says that he restricted his conclusions to the results of "pressure alone," and quotes Teall as saying that "Pressure alone produces no effects on rocks; and Fisher—"Pressure by itself cannot develop heat." [Since heat is energy, a mere *state* of pressure cannot, of course, develop it; but if, on the dissipation of the original heat, or from any other cause, contraction takes place, and the rock *yields* to pressure, this yielding may result in the development of heat. The question raised is whether "pressure alone" in this sense, *i.e.*, unaided by either water or plutonic heat, can metamorphose a rock. Gen. McMahon shows that, in the case of the Bude rocks—which have not only been pressed, but have yielded to pressure—no change has occurred; but he has not proved that changes *cannot* occur. They may, as far as proof goes to the contrary, have been directly brought about by pressure, even without the energy having been converted into the intermediate form of heat; in fact, Prof. Judd's explanation of Spring's experiments, as quoted above, is an illustration of the method.]

The writer says there are some geologists "who contend that pressure produces metamorphism, even in cases where the rock masses do not yield to the pressure exerted on them." [Pressure may be considered a necessary condition, but no one, except a paradoxist, could imagine the *energy* required to be obtained from nowhere. The question, however, is raised, whether the energy required is obtained from *external* stresses, or whether the unmetamorphosed ingredients contain stored-up energy, which is lost on stable crystals being formed, *i.e.*, whether the energy is *internal*. In the former case great pressure might be required, in the latter, only sufficient to start the action.]

575. Fisher, O.—On Dynamo-Metamorphism.

Geol. Mag., Dec. 3, vol. vii., p. 303.

This is an attempt to give "help towards understanding Mr. Harker's instructive" [and perfectly lucid] "letter" on the effects of strains on rocks. He gives a geometrical figure. and shows, under certain supposed conditions, what amount of the energy would be available for producing heat, &c. [But it is difficult to follow either the meaning or the argument as in such a sentence as "But this conclusion does not follow unless heat longer retained is rendered conducive to mineralogical chemical reactions by the consequent increase of temperature."]

576. Irving, H.—Note on Dynamic Metamorphism.

Geol. Mag., Dec. 3, vol. vii., p. 562.

Repeats Mr. Harker's explanation in less clear language, and doubts whether, under any circumstances, the heat from pressure would be of any consequence. He twits Mr. Fisher with using the phrase "molecular form of chemical action," and says it ought to be "atomic" [but in chemical changes *molecules* interact, and by a redistribution of their respective atoms produce new *molecules*].

577. Green, A. H.—Dynamic Metamorphism of Rocks.

Paper read to the Ashmolean Society, Oxford, on Feb. 24, but not published in 1890.

578. Marr, J. E.—Dynamic Metamorphism of Skiddaw Slates.

Rep. Brit. Ass. for 1889, p. 568.

In the Skiddaw Slates on the west side of Cross Fell escarpment from Melmerby to Roman Fell several large masses of quartz veins occur, trending generally W.N.W. to E.S.E. The best exposure is on the east side of Brownber, where the quartz veins were evidently intruded along bedding planes before the main folding took place. They are now extremely contorted, and are converted into a rock, composed largely of mica and secondary quartz, and show "answeichungs clivage" [strain-slip cleavage]. They contain many cubes of pyrites, slightly deformed, and surrounded by a fibrous mineral. The slates are only thus altered where there are quartz veins, and as these are previous to the principal folding, they are not the cause of the alteration, which is due to the differential movement between hard quartz and soft slate, as shown by the universal slickensiding of the divisional planes.

579. Gardiner, Miss M. T.—Contact Alteration near New Galloway.

Q.J.G.S., vol. xlvi., p. 569, pl. xxiii.

The alteration is produced by the Cairnsmore-in-Fleet Granite, on the northern side of Knocknairling Hill. The altered rocks are of Silurian age, and part have been called the Queensberry Grits, and part belong to the Moffat Shales. The rocks strike nearly perpendicularly to the line of junction with the granite, and a section across them, about ¾ mile away, is seen in Knocknairling Burn. Grits and shales are seen here, the principal varieties being: 1. Purple brown grit, with brown mica [apparently secondary, as there are patches without any]. 2. Knotted schist. The knots being of finer grain. Some have crystals, with many inclusions. 3. Garnet-bearing grits. Two sets of beds can be traced up to the granite from half-way up the hill. 1. Shales. At ¼ mile from the granite these are crumpled into frills, with

lenticles of quartz. Sometimes the quartz grains and mica segregate into separate patches; some have oval patches of plagioclase. The amount of alteration at the same distance is very variable. Within three yards of the granite, these become a light grey granular rock, with black patches. In this there is much white mica, with intergrowths of brown mica; most of the rock is granular quartz; in patches it becomes coarser and more granitic looking, but the brown mica and colouring matter distinguish it. 2. Flags and Grits. Farthest from the granite there are schistose bands, chiastolite shales, and quartzose rocks, with varying arrangements of garnet and brown mica; there are garnetiferous quartz lenticles; the rocks are folded in angles, and cleave from apex to apex. Two hundred yards from the granite, the purple grits have brilliant white mica flakes, some parts are fine grained, others are of larger secondary quartz; the whole is flecked with bundles of needles of sillimanite. There is also brown mica, and a little tourmaline. At 100 yards, the rock is coarser, and resembles a gneiss. There is much white mica, nests of black mica, and intervening branching patches of quartz, with garnets, and there is abundant sillimanite. At the junction, the rock is still coarser and more banded, and has large light-coloured lenticles surrounded by white mica, studded with garnet. There are branching ivory-like masses of small flakes of white mica with sillimanite. The whole has lost all signs of its clastic origin. The main part of the lenticles consists of garnets. Amongst these grits are unaltered shales, and mica schists with large chiastolites; water clear, and containing garnet; and there are also quartz-garnet lenticles surrounded by irregular chiastolite. Both granites and sedimentaries are veined by aplite, with white mica, garnets and tourmaline—the last arranged graphically. The authoress draws attention to the extreme variation in the amount of alteration at equal distances, to the greater distance to which the grits are altered, to the order of inclusion—quartz within garnet within chiastolite within mica, to the folding previous and subsequent to the alteration, to the transference of material from spot to spot, which she attributes to the action of highly-heated water.

580. Worth, R. N.—Contact Metamorphism in Devonshire.

Trans. Devon Assoc., vol. xxii., p. 169.

He notes that at Plym Bridge, and on the edge of Dartmoor, by Ugborough Beacon, rocks like adinole, &c., may be seen near diabase intrusions. The effects of the Dartmoor Granite is the most marked in the Devonian rocks to the south-west, near Shaugh; spotted schists, with andalusite,

become later micaceous schists, and finally a hornfels is produced. Clay slate is changed to a soft talcose schist at Yeoland Consols, and Slade. The hornfels, he thinks, may be due to something else than the extreme of metamorphism. The lines of junction are never obliterated. Tourmaline is found in the altered grits near Okehampton and Great Tor. Veins occasionally produce marked changes, but not all. He has a junction specimen between schorlite and schorl schist—one was originally igneous, the other sedimentary. but both have the same constituents and are now only distinguished by one being crystalline the other foliated—"the evidence of their differing origins." [But it is to be presumed not the only evidence.] The effect of the granite on the hornblende slate at Toybridge is to convert it into "ribbon jasper," which he also calls "prase schist." At Belstone Common, red garnet is produced, and at Meldon, grossularia. At Leatherton is a finely-banded garnet schist.

581. McMahon, C. A.—On the Manufacture of Serpentine in Nature's Laboratory.

Proc. Geol. Assoc., vol. xi., p. 427.

The object of this paper is to explain the exact process by which serpentine is produced by the alteration of other minerals. As this is brought about by the agency of water, the first thing is to show how the water gains access to the mineral elements of the rock. The entrance of water into permeable rocks is easy to understand, but beyond this, it finds its way into the heart of the hardest minerals. The writer introduces Boscovitch's theorem, that molecules within a certain distance have a repellant rather than an attractive force, in order to show that there must be molecular interspaces in minerals. Since the alteration of these minerals begins sometimes in the centre, when the channels through which chemical constituents have been abstracted or introduced are too small to be revealed by the microscope, he thinks they must have come in by these invisible pores [in which case, why do they not alter the outside as they pass by?]. Minute cracks, however, are also present, as is shown by granite and greenstone absorbing water, and containing air, and the capillary action is increased by pressure and heat. [He seems to think, however, that the same conditions would facilitate the introduction of water into the intramolecular spaces, since] "heat signifies an increase in the force of repulsion that keeps apart the atoms [*sic*] and molecules of which these minerals are composed." [in which case, heating should make a compound take up more water, but, *e.g.*, "the hydrate of sodium sulphate is more and more thoroughly converted into the anhydrous salt as the temperature increases." (Fownes.)]

He then enters into the chemical question, and explains how carbonic acid will decompose silicates of magnesia and iron. The principal mineral altered being olivine, he shows that if from 2 molecules of this, $(MgFe)_4 Si_2O_8$, one molecule of ferro-magnesian oxide is removed, Mg Fe O, and two molecules of water added, H_4O_2, we get Serpentine, $H_4 (Mg Fe)_3 Si_2O_9$, but "as this involves an increase of volume some silica may also be removed." [This last suggestion will, of course, alter the above, and bring it into harmony with the method suggested by Roth, as quoted by Teall (Brit. Petrography, p. 106) *i.e.*, 5 molecules of olivine $= 10\ MgO + 5\ SiO_2 - (4\ Mg\ O + Si\ O_2) + 4\ H_2O = 6\ Mg\ O, + 4\ Si\ O_2 + 4\ H_2O = 2$ molecules of Serpentine. In one case 5 molecules of olivine are supposed to produce 2 molecules of serpentine, in the other 2½, but in neither case is the connection of this with the volume explained]. Serpentine may also be produced from Enstatite, Malacolite, or Tremolite, and in these cases it appears necessary to add magnesia, which may be obtained as above by the prior decomposition of olivine. The change from olivine may be seen begun in fresh crystals from the Puy-de-Dome.

He gives as an appendix a table of pressures of the water in the Severn Tunnel, compared with the height of water in the porous overlying strata, showing that the former is always proportional to the latter, and in no way dependent on the strata themselves, which cause no pressure, but only supply pores.

582. Somervail, A.—On the Nature and Origin of the Banded Structure in the Schists and other Rocks of the Lizard District.

Geol. Mag., Dec. 3, vol. vii., p. 505.

The author gives localities where the banded structure may be seen. It ranges from "well-defined banding of a . . . regular . . . horizontal type," to "highly irregular bands, thinning and swelling out again." He then discusses the cause. He rejects lamination because the rocks are not sedimentary. He objects to the "deformation" theory—1. The great symmetry of the banding in some cases; 2. The gradual passage from one type of rock to another in some places, instead of a sharp distinction; 3. The banding being found in pure granulites. To the "injection" theory he replies that the parallel bands are nowhere *seen* to intrude into each other. He thinks the banding is due to segregation, or the crystallizing out of the materials into distinct bands while cooling. He gives as an illustration a concretionary mass of granulitic rock at Kildown Cove, where the structure is in circular [does he mean spherical?] form, of concentric layers. [Unfortunately, he nowhere says *why* this

and similar phenomena are "convincing to his mind."] He clearly, however, distinguishes this "normal or true banding" from others "due to . . . mechanical pressure," which last he calls "lenticular foliated structure," in which secondary segregation has taken place. [Different from either is cleavage foliation.]

583. McMahon, C. A.—Banded Rocks of the Lizard.

Geol. Mag., Dec. 3, vol. vii., p. 574.

Brings forward against the idea of "segregation" on the large scale, the numerous examples in which different kinds of rock cut each other in well-marked dykes.

[**584.**] **Somervail, A.**—The Banded Structure of Rocks.

Paper read to the Torquay Natural History Society on May 14, but not published in 1890.

585. Teall, J. J. H.—Metamorphism in the Hartz and West of England.

Trans. Roy. Geol. Soc. Cornwall, vol xi., p. 221.

This is a general sketch, taken from the writings of K. A. Lossen, of the igneous and other rocks which, in the Hartz, have produced or suffered either contact or regional metamorphism. Very little of the same kind has been observed in the West of England, and the object of the paper appears to be to excite local geologists to look out for analogous rocks and results.

586. Bonney, T. G.—The Effects of Pressure on Crystalline Limestones.

Rep. Brit. Ass. for 1889, p. 571.

Published *in extenso* in the Geol. Mag. for Nov., 1889. The Mesozoic limestones of the Alps are not more distinctly crystalline than the later Palæozoic limestones of Britain, but the limestones associated with the crystalline schists are coarser, except where they have been broken down by pressure.

587. Waller, J. H.—The Processes of Crystallization in Rocks.

"Midland Naturalist," p. 14.

A general review of known facts, viz., that the higher the original temperature the more likely is the rock to be glassy on rapid cooling. Magnetite is the first to crystallize out, then olivine. Augite and felspar interchange order; basic materials crystallize first, therefore the matrix is more siliceous; crystals of first consolidation are uniformly distributed when the matrix varies; inclusions are sometimes arranged in zones and bands; globulites and spherulites, and the clear margin round the larger microlites, are noticed.

588. Chapman, F.—On a Method of Producing Perlitic and Pumiceous Structures in Canada Balsam.

Geol. Mag., Dec. 3, vol. vii., p. 79.

He finds that to produce perlitic cracks a roughened surface is necessary. The Canada balsam is hardened to brittleness, poured on to *ground* glass, and, when nearly cold, the glass and all is plunged into water. The coarseness of the resulting structure depends on the thickness of the mass and the coarseness of the surface of the glass. Pumiceous structure is imitated by beating up brittle Canada balsam in a hot state, so as to include air bubbles, and pulling the mass out several times. These experiments *illustrate* our notions of the origin of these two structures.

589. Johnstone, A.—A Theory of the Devitrification of Igneous Rocks.

Trans. Edinburgh Geol. Soc., vol. vi., p. 106.

He suggests that margarites are produced by "magnetic attraction." They fuse into lingulites by "chemical affinity," and become microliths by "acquiring crystalline attributes." The microlites "attract each other by dissimilar ends," "like a series of bar magnets," and twins are thus formed, chemical action coming into play too late to effect a complete coalescence.

SEDIMENTARY ROCKS.

590. Hutchings, W. M.—Notes on the Probable Origin of some Slates.

Geol. Mag., Dec. 3, vol. vii., pp. 264, 316.

This paper deals with the materials of a clay. The beds examined are Coal Measure clays of three degrees of coarseness, at Seaton, near Newcastle. The method of preparing thin films is given—it consists of rubbing down one side dry, mounting it in Canada balsam, then rubbing down thin on emery cloth, and finally with water on a glass plate, using great care. In the coarser material are found quartz, felspar, zircon, and biotite and muscovite; also a few crystals or fragments of anatase and tourmaline. Some colourless rhombic crystals are referred to barytes, supposed to be formed from circulating solutions. The muscovite is fresh, the biotite is more or less altered. The whole material may thus be derived from a granite with two micas. The biotite becomes bleached and produces minute aggregates of epidote and sometimes rutile. The intervening paste, more abundant in the finer material, contains immense numbers of minute rutile crystals and small micaceous elements, also minute flakes of secondary mica; the remainder may be called kaolin. The author thus concludes that fire-clays such as this cannot be rightly said to be made of kaolin, and believes

that in the decomposition of felspar, mica is an intervening stage between it and kaolin. The titanic acid of the rutiles comes probably from the alteration of the biotite, a mineral known to contain at times as much as 4 per cent. of titanic acid, which is not recorded from the other minerals which occur in sufficient abundance in granite. The smaller flakes of biotite are altered in a different way to the larger by mixing more freely with the other minute ingredients to form new mica or sericite, which probably contains magnesia. These results give a reason for the absence of biotite and the abundance of minute rutile in Welsh and Cornish slates. The main constituent of these is a small-grained mica, lying flat in the plane of cleavage, which he regards as secondary (though Dr. Sorby and Pfaff concluded the contrary.) The Welsh slates contain numerous original grains of quartz and felspar, but the Tintagel slate contains neither. The latter have undergone more dynamic change, and "dynamo-metamorphic biotite" has been produced. No slates contain the granular impure "kaolinitic" material. He concludes, in a note, that the rutiles observed in the Seaton clays are proved to be secondary, because they are "clays whose exact and direct origin can be pretty clearly demonstrated," *i.e.*, from granite which contained no rutiles. [This seems to want a little more proof.]

591. Platt, S. S.—Notes on the Paving Stones used at Rochdale.

Trans. Rochdale Lit. and Scient. Soc., vol. ii., p. 4, with a Plate.

The sedimentary rocks in use are "The Second Grit" and Coal Measure Gritstone, but these are only suitable for light traffic.

The igneous rocks are enumerated in the order of their hardness, and each is more or less described from the works of previous writers. They are :—1. Penmaenmawr. The Eastern quarry yields too fine a stone. 2. Clee Hills. 3. Whinstone. 4. Welsh Granite from Yr Eifl. 5. Llanbedrog, four miles S.W. of Pwllheli — a "granitporphyr." 6. St. John's Quartz Felsite, Threlkeld. These are the lasting stones. The remainder are useful where it is essential not to be slippery. 7. Gimblet Rock Pwllheli. 8. Breidden Hills. 9. Dalbeattie, Kirkcudbrightshire, very coarse. 10. Newry, Ireland, Granite.

The following analyses are given which may be new. I. Penmaenmawr stone, from Western Quarries. II. From more easterly. III. Gimblet Rock :—

	I.	II.	III.
Silica	56·25	59·95	46·65
Alumina	18·02	16·43	21·33
Ferric oxide	3·81	6·43	3·69
Ferrous oxide	3·70		5·79
Lime	6·90	7·43	8·29
Magnesia	5·04	4·42	8·06
Potash..	2·76	2·00	1·25
Soda	1·90	2·80	1·58
Carbonic acid	0·50	—	0·95
Sulphuric acid	0·03	—	0·16
Combined water ..	1·09	·54	2·25
	100·00	100·00	100·00

Figures of microscopic sections of each of the varieties of rock are also given.

592. Harker, A.—Notes of North of England Rocks, III. "The Naturalist," p. 300.

This deals with the oolites of Yorkshire, and describes their microscopic structure. 1. Millepore Oolite from Brough. This has a crystalline mosaic matrix and various recognizable fragments. 2. Ditto from Cockle Quarry has more quartz fragments. 3. Ditto at Sancton, every grain, even the quartz, is coated. The original arragonite nature of those shells which are made of it is shown by the replacing calcite being structureless and crystalline. 4. Ditto from Whitwell limestone, Westow, has composite oolite grains and crystalline matrix. 5, Scarborough limestone from Wheatcroft has many quartz grains and yellow crystalline matrix, perhaps chalybite. 6. The nodular ironstone bands have a similar structure, but without oolitic grains (?) 7. Cornbrash from Gristhorpe has many quartz grains and shell fragments. 8. Lower Calcareous Grit of "Ball beds," from Filey, much stained with iron oxide, has angular grains of quartz. 9. Lower Limestone ditto shows sections of *Rhynchonella*, which have a layer of crystalline calcite inside the structure-bearing shell, which "suggests that the shell had originally an inner layer of arragonite." The matrix is very fine grained. 10. Middle Calcareous Grit ditto has numerous angular grains. 11. Upper Limestone ditto, same type, with shell fragments detectable by the structure. 12. Coral oolite from Peasy Hill, Malton. The shells are calcified, and the coats of oolite grains numerous.

593. Goodchild, J. G.—On some Abnormal Deposits of Limestone.

Trans. Edin. Geol. Soc., vol. vi., p. 75.

This is the same as the paper in the Geological Magazine, but he acknowledges his views to have been anticipated by a different line of reasoning in Messrs. Irvine and Woodhead's paper. (Proc. Roy. Soc. Edin., vol. xvi., p. 324.

594. Goodchild, J. G.—Dolomitic Limestones.

Trans. Edinburgh Geol. Soc., vol. vi., p. 96.

Dolomites of primary origin are due to:—1. Precipitation (*a*) in closed bodies of inland water; (*b*) consequent on the desiccation of lagoons; (*c*) upon the mingling of various solutions. 2. Deposition direct from percolating solutions, derived from the decomposition of basic igneous rocks, situated at higher levels. 3. Calcareo-magnesian matter, exuded in consequence of the alteration of rock-forming silicates. 4. The secretion of carbonate of magnesia along with carbonate of lime by various organic agencies. [No examples or proofs are given in illustration of these statements.]

Dolomites of secondary origin have nearly all arisen through the addition of magnesian salts to already existing limestones; though, in the case of the magnesian limestone, it may have been partly of primary origin. This addition has taken place through the downward percolation from the Sandstones of the "Upper New Red." This results in diminution of bulk in the limestone [probably substitution is intended, but it is not so stated], and this causes the rock to have a loose texture, and to form geodes and botryoidal structures. We may conclude from this that where the Carboniferous Limestone is thus altered, the New Red Sandstone formerly overlay it, though it is now denuded. [The abstractor of this paper for the "Transactions," states that the New Red rocks bear the same relation to the Jurassic that the Upper Old Red does to the Carboniferous; and considers that "it would follow from this conclusion that the writer [J. G. G.] believes that the Jurassic rocks also extended over the south of Scotland"; but as nothing is said, or could be said, in this connection about Upper Old Red, the author is probably misrepresented here.] This introduction of magnesia was one of the first steps towards the introduction of hæmatite.

595. Johnstone, Alex.—The Composition and Origin of the Rock Dolomite.

Trans. Edinburgh Geol. Soc., vol. vi., p. 89.

He commences by taking exception to the statement that the rock dolomite is a double carbonate of calcium and magnesium, because so many examples of [so-called] dolomites show a less proportion of magnesium carbonate than is required to produce this salt [in other words, he has not learnt to distinguish between a true dolomite and a magnesian limestone], and he concludes that the two carbonates are merely in a condition of simple mechanical mixture [this can scarcely be the case when the rock is crystalline, and the separated crystals approximate in composition to the theo-

retical composition of the double salt]. He states that massive dolomite "is evidently in its original state, and has not been produced by metamorphic action" [the word "evidently" is generally used when no proof is forthcoming, and in this case, as we find crystalline interior casts of shells, the material can scarcely be in its original state]. He objects to the supposed reactions taking place in sea water [but gives no grounds for the objection]. His theory is that the carbonates of magnesia and lime are precipitated on reaching the sea, owing to their less solubility in that medium. [This may very probably be the case with ordinary more or less magnesian limestones; but the real question is how the carbonate of magnesia, in true dolomites, comes to be in so much larger proportion than in river water. See Prestwich's Geology, vol. i., p. 115.]

596. Goodchild, J. G.—The Paste of Limestones.

Geol. Mag., Dec. 3, vol. vii., p. 73.

The author is dissatisfied with the ordinary theory of the origin of limestones by the detrital or chemical breaking up of organic structures, and considers it due to chemical precipitation. He asks how it is that while rivers carry abundant carbonate of lime to the sea, the neighbouring sea water has scarcely a trace? [But can such a statement be any longer sustained in face of the results of Dewar's investigations of the composition of sea water (Challenger Reports, Physics and Chemistry, vol. i., p. 204), wherein he shows that there is actually more carbonate of lime in the sea than in average rivers; but, as he states, even this is not certain? The acids are estimated separately from the bases, and their union is hypothetical. But, in any case, the work of organisms is not to reduce the amount of carbonate of lime to zero, but to prevent it accumulating.] The author suggests the reaction brought forward by Sterry Hunt—viz., that the carbonate of lime in the river water reacts on the sulphate of magnesia in the sea water [and, he ought to say, precipitates it] leaving sulphate of lime in solution. [He takes no notice, however, of the carbonate of magnesia, which ought, according to this theory, to accompany every limestone; in other words, all limestones ought to be dolomites.] He then refers to researches by Messrs. Irvine and Woodhead, which show that animals *can* convert any compound of lime into the carbonate [which does not show that they *do*]. He then suggests [what is doubtless true] that decaying organisms decompose the sulphate, and precipitate it [but it does not appear that limestones can, in general, even thus be formed without organic aid].

597. Mannington, H. T.—Note on a Calcareous Deposit near Flint.

Journal Liverpool Geol. Assoc., vol. ix., p. 57.

This is a bed of travertine in the form of a pond at Coed Onw. It was exposed in making a filter bed for the Flint Gas and Water Co. Its interest lies in the fact that it is four miles from the nearest limestone, and much change in the surface of the country must have taken place since its formation.

[**598.**] **Reid, A. S.**—Concretions and Concretionary Actions.

Paper read to the East Kent Natural History Society on Jan. 13.

599. Hind, W.—Notes on the Curious Appearance Produced by the Natural Bisection of Some Spherical Concretions in a Yoredale Sandstone Quarry.

Proc. Geol. Assoc., vol. xi., p. 424.

The quarry is at Gun Hill, Leek. On the lower surface of some overhanging slabs are seen a series of concentric striæ reaching a diameter of 9—16 inches, and from $\frac{1}{16}$ to $\frac{1}{8}$ or even $\frac{1}{2}$ inch deep. These are found to be central sections of hemispheres which lie in the rock above. Both rock and hemispheres are of close grained semi-crystalline quartz. On the upper surface of slabs in the same quarry, hemispheres of like size project; but these are found to be the exposed portions of complete spheres, in the interior of which no structure can be seen. Nowhere in the quarry have the lower halves of the spheres been discovered. He concludes that these are concretions which have been split in half by a fault along the bedding, and their structure brought out by some undefined chemical process. [The accompanying figure, from its bad perspective, is confusing.]

ECONOMICS.

MINERALS.

600. Mineral Statistics of the United Kingdom for 1889. London, 8vo, H.M. Stationery Office.

The numbers are given in tons.

Alum Clay (Bauxite).—Antrim, 9,150 tons.

[*Aluminium*—Northumberland and Worcester, 12,000 lbs. of Aluminium made from materials of British origin.]

Alum Shale.—Yorkshire, 4,172; Stirling, 16.

Antimony Ore.—Dumfries, 66.

Arsenic.—Cornwall, 1,927; Devonshire, 2,150.

Arsenical Pyrites.—Cornwall, 2,443; Devonshire, 5,245.

Barytes.—Cumberland, 194; Derbyshire, 796; Devonshire, 1,200; Durham, 87; Montgomery, 933; Northumberland (Carbonate), 6,486; Shropshire, 4,838; Westmoreland, 1,015; Yorkshire, N., 829; do. W., 2,083; co. Cork, 6,388.

Bog Ore (for purifying gas).—Dublin, 6,417; Londonderry, 2,268; Sligo, 220; Mayo, 5,097.

China Clay and Stone.—Cornwall, 394,943; Derbyshire (with Fireclay), 7,843; Devonshire, 87,056; Dorset, about 50,000; Flintshire (Buckley Fireclay), 114,935; Lancashire (Stone Clay), 8,243, (Fireclay), 5,000; Leicester, 28,664; Surrey (Fuller's Earth), 6,000; Yorkshire, N. Riding (Fireclay), 800.

[Exports of Clay:—To Russia, 17,405; Sweden and Norway, 8,582; Germany, 42,773; Holland, 31,382; Belgium, 47,116; France, 33,343; Spain, 8,703; Italy, 9,689; U.S.A., 32,550. Other countries, 18,213.]

Fireclay.—Brecon, 8,168; Carmarthenshire, 16,416; Cheshire, 4,398; Cumberland, 40,424; Denbighshire, 33,561; Derbyshire, 33,071; Durham, 586,611; Flintshire, 18,016; Glamorganshire, 123,640; Gloucestershire, 7,110; Lancashire, 104,030; Leicester, 43,201; Monmouthshire, 97,745; Northumberland, 183,759; Nottinghamshire, 977; Shropshire, 15,170; Somersetshire, 258; Staffordshire, 194,140; Warwickshire, 30,720; Worcestershire, 99,170; Yorkshire, 207,393.

Ayrshire, 73,049; Clackmannan, 4,635; Dumbarton, 31,110; Dumfries, 669; Edinburgh, 46,903; Fife, 12,799; Haddington, 6,114; Lanark, 266,433; Linlithgow, 20,382; Renfrew, 32,136; Stirling, 46,193.

Tyrone, 4,008.

Other Clays.—Glamorganshire (Yellow), 15,175; Shropshire (Red), 42,805; Bedfordshire (Fuller's Earth), 22; Buckinghamshire (Fireclay), 275; Devonshire (Potters' Clay), 31,768; Dorsetshire (Fireclay), 8,980, (Potters' Clay), 28,115; Somersetshire (Fuller's Earth), 6,528; Surrey (Fuller's Earth), 5,165.

Meath (Marl), 1,590.

Coal.—Brecon, 233,675; Carmarthenshire, 710,977; Cheshire, 620,101; Cumberland, 1,739,491; Denbighshire, 2,180,516; Derbyshire, 10,093,232; Durham, 30,307,177; Flintshire, 715,183; Glamorganshire, 20,297,004; Gloucestershire, 1,359,814; Lancashire, 21,707,867; Leicestershire, 1,336,574; Monmouthshire, 6,751,308; Northumberland, 8,794,005; Nottinghamshire, 6,582,582; Pembrokeshire, 71,271; Shropshire, 710,490; Somersetshire, 876,254; Staffordshire, 13,937,406; Warwickshire, 1,700,490; West-

moreland, 1,246; Worcestershire, 893,880; Yorkshire, 21,976,027.

Argyle and Dumfries, 102,810; Ayrshire, 3,120,363; Clackmannon, 152,146; Dumbartonshire, 327,624; Edinburgh, 860,846; Fifeshire, 2,761,616; Haddingtonshire, 276,773; Kinross, 53,655; Lanark, 13,159,704; Linlithgow, 775,440; Renfrew, 48,391; Stirling, 1,377,802.

Connaught, 9,469; Leinster, 79,979; Munster, 8,116; Ulster, 5,638. Total, 176,916,724.

[Coal was exported to 65 countries to the amount of 27,504,911 tons.]

Cobalt and Nickel Ore (containing 2·03 per cent. Cobalt, and 1·09 per cent. Nickel).—Flintshire (Rhyl), 155.

Copper Ore.—Anglesey and Isle of Man, 421; Cardigan, 20; Carnarvonshire, 818; Cornwall, 4,959; Devonshire, 2,659; Lancashire, 100; Merionethshire, 24.

Ireland, 28. [Metallic copper exported, 13,324 tons.]

Copper Precipitate.—Anglesey and Isle of Man, 264; Cornwall, 3.

Ireland, 14.

Fluor Spar. — Cornwall (no return); Derbyshire, 263; Durham (Weardale), 34.

Gold Ore.—Merionethshire, 6,226 (containing 3,890 ozs. of gold, of which 3,864 ozs. is from the Morgan Gold Mining Co.)

Gypsum. — Cumberland, 13,730; Derbyshire, 10,201; Nottinghamshire, 85,140; Staffordshire, 15,320; Sussex (Sub-Wealden), 3,166; Westmoreland, 4,800.

Ironstone (Argillaceous Carbonate).—Brecon, 512; Carmarthenshire, 118; Cumberland, 1,594,461; Denbighshire, 231; Derbyshire, 18,689; Devonshire, 3,280; Durham, 3,991; Glamorganshire, 35,807; Gloucestershire, 52,156; Lancashire, 1,021,990; Lincolnshire, 98,282; Monmouthshire, 17,435; Nottinghamshire, 992; Shropshire, 44,630; Somersetshire, 1,400; Staffordshire, 1,262,678; Warwickshire, 1,723; Worcestershire, 10,869; Yorkshire, 5,728,314.

Ayrshire, 468,685; Dumbartonshire, 108,463; Edinburgh, 56,707; Fifeshire, 6,817; Kinross, &c., 13,506; Lanark, 136,944; Linlithgow, 100,821; Renfrew, 138,862; Stirling, 30,927.

Antrim, 164,686. [Exported 5,371.]

Iron Pyrites (with Copperas lumps).—Anglesey, 21; Carnarvonshire, 5,587; Derbyshire, 1,354; Lancashire, 133; Nottinghamshire, 268; Shropshire, 455; Staffordshire, 1,256; Warwickshire, 2,049; Yorkshire, 214.

Dumbartonshire, 73; Lanark, 9.

Wicklow, 6,300.

Jet.—Yorkshire (Runswick, Sandsend, Hinderwell), 618 pounds.

Lead Ore.—Brecon, 162; Cardiganshire, 1,861; Carmar-

thenshire, 668; Carnarvonshire, 1,223; Cumberland, 2,111; Denbighshire, 1,389; Derbyshire, 4,957; Durham, 10,000; Flintshire, 4,663; Isle of Man, 6,433; Montgomeryshire, 1,075; Northumberland, 3,789; Pembrokeshire, 120; Shropshire, 1,972; Westmoreland, 1,704; Yorkshire, 2,056.

Scotland, 4,063.

Ireland, 218.

Lignite.—Devonshire (Bovey Tracey), 947.

Magnesium (manufactured from British materials).—Quantity unknown.

Manganese Ore.—Carnarvonshire, 147; Derbyshire, 34; Merionethshire, 8,671.

Ochre, Umber, &c.—Anglesey and Isle of Man, 5,096; Cornwall, 10; Cumberland, 58; Derbyshire, 218; Devonshire (no return); Lancashire, 261; Somerset, 4,261.

Wicklow, 590.

Oil Shale.—Flintshire, 2,132; Staffordshire, 17,692; Yorkshire, 8,046; Ayrshire, 24,275; Edinburgh, 664,555; Fifeshire, 131,242; Lanark, 13,213; Linlithgow, 1,152,386; Stirling, 1,319.

Petroleum.—Derbyshire, 30.

Phosphate of Lime.—Bedfordshire and Buckinghamshire, 7,000; Cambridgeshire, 10,000; Suffolk, 3,000. [Imported, 304,953.]

Salt.—Cheshire (Rock), 141,063; (Brine), 1,342,896 = 1,483,959; Durham (Brine), 191,647; Staffordshire (do.), 6,450; Worcestershire (do.), 217,798; Yorkshire (do.), 26,500.

Antrim (Rock), 20,142. [Exported, 666,757.]

Silver (derived from Lead ore), in ounces.—Cardiganshire, 10,262; Carmarthenshire, 2,881; Carnarvonshire, 3,523; Cumberland, 13,942; Denbighshire, 289; Durham, 54,263; Flintshire, 28,925; Isle of Man, 139,304; Montgomery, 8,891; Northumberland, 1,341; Pembrokeshire, 458; Westmoreland, 15,734.

Scotland, 24,943.

Ireland, 832.

Total Silver from Lead ore, 306,149 ozs.; from Cupriferous Iron Pyrites, 317,072 ozs.

Slates and Slabs.—Brecon, 117; Carnarvonshire and Denbighshire, 274,142; Cornwall, 12,658; Cumberland, 2,372; Durham, 1,522; Merionethshire, 147,086; Montgomery, 1,116; Westmoreland, 1,886; Yorkshire, 13,602; Cardigan, 310; Devonshire, 1,230; Lancashire, 1,585.

Dumbarton, 800; Argyle and Perthshire, no return.

Stone.—Returns not given; estimates only attempted: Coal-fields (Ganister), 170,225; Buckinghamshire (Chalk), 740; Derbyshire (Chert), 2,810; (Calc spar), 4,364; (Hydraulic Limestone), 4,200; Shropshire (Calc spar), 482; Worces-

tershire (Dudley Limestone), 53,316; Suffolk (gun flints from Lingheath), 3,703,000 in *number;* Ayrshire (Honestone), 256; Gloucester, Lancashire, Northamptonshire, Somersetshire, Wiltshire, Yorkshire, Scotland (Building stone), no return.

Shontia Sulphate.—Gloucester and Somerset, 5,976.

Tin Ore.—Cornwall, 13,755. Devonshire, 53.

Wolfram.—Cornwall [East Pool Illogan Mine], ½.

Zinc Blende and Calamine.—Anglesey, 98; Cardigan, 3,787; Carnarvonshire, 81; Cornwall, 129; Cumberland, 4,830; Denbighshire, 6,913; Derbyshire, 41; Flint, 1,609; Isle of Man, 4,596; Montgomery, 775; Northumberland, 30; Pembrokeshire, 65; Shropshire, 176.

Dumfriesshire, 72.

601. Collins, J. H.—A Practical Dictionary of English and Foreign Mining, Metallurgical, and Mineralogical Terms.

Thirty-eight articles in the "Colliery Guardian," vols. lvii., lviii.

[**602.**] **Oswald, R. P. W.**—Mineral Industries of the North.

Paper read to the Whitehaven Scientific Association, and reported in the local papers.

[**603.**] **Postlethwaite, J.**—The Deposits of Metallic and other Minerals Surrounding the Skiddaw Granite.

Paper read to the Cumberland and Westmoreland Association.

[**604.**] **Strahan, A.**—The Geology of the Neighbourhoods of Flint, Mold, and Ruthin.

Memoirs of Geol. Survey, chapter xiii., Metalliferous Mines.

The principal metals here worked are lead and zinc. The lead occurs as galena, usually argentiferous, and as carbonate. The zinc occurs as blende or as calamine. Hæmatite also occurs in the Lower Carboniferous Limestone, but not in workable quantities, and only an occasional mass of copper pyrites or manganese ore has been met with.

The lodes occur either in "veins," which run east and west and cross the strike of the rocks, or in "cross courses," which run north and south along the strike; the former are the most prolific. The veins show blende and galena, but the cross courses have no blende, but specks of copper pyrites. The spar is also siliceous in the veins and clayey in the cross courses. The latter are later in date than the former. Much galena is raised from flats, which are horizontal masses in calc spar along N. and S. joints. Much is also obtained from surface *débris*, and is known as "gravel ore." The ores are most productive immediately below the lowest Coal Measures, or Holywell shales, and also become more so under any band of shale. The veins are best when in the

chert beds, and become less productive when these change to sandstones, and their richness is transferred to the Carboniferous Limestone below. The writer considers the ores to be derived from the limestones and precipitated, particularly where sulphuretted hydrogen is produced by decomposition of pyrites in the shales. A list of 30 " veins " is given, all yielding 75—80 per cent. of lead, and 4 or 5 ozs. of silver per ton.

The various mines are then described in detail by districts. 1. Holywell, with the old Holloway, and Milwr and adjoining veins; 2. Halkin Mountain; 3. From Bryn-gwrog to Rhydymwyn; 4. From Rhydymwyn to Gwern-y-Mynydd; 5. From Gwern-y-Mynydd to Maes-y-Safn; 6. From Maes-y-Safn to Llanarmon. Each of these contains numerous veins, the details of which are of very local interest; but several sections are given along the veins to show the distribution of the ore in them, which resembles in outline the forms of peninsulas and archipelagos.

605. Collins, J. H.—On the Origin and Development of Ore Deposits in the West of England.

Journal Roy. Inst. Cornwall, vol. x., p. 109, pt. x.

This commences with an exposition of the phenomena of rocks in general, as in a text book. We then have five chapters. I. Formation of Structural Planes in Rocks Masses.—A text book chapter. II. The Mechanical Phenomena of Faulting.—The same, but with some illustrations from mining districts. There are no more chapters. The rest is probably to come.

[**606.**] **Mills, M. H.**—A Few Notes on the Leicestershire Ironstone Field.

Paper read to the Chesterfield and Midland Counties Institute of Engineers.

[**607.**] **Carr, J.**—Notes on Tin Ores and the Tin Mines of Cornwall.

Paper read to the Dundee Naturalists' Society on Feb. 19, but not published in 1890.

608. O'Reilly, J. P.—Notes on some Assays for Gold of Rocks Occurring in the Neighbourhood of Dublin.

Proc. Roy. Dub. Soc.

The diorite with which Dublin streets are metalled contains 2 dwt. of gold per ton. The clay slate of Crookling Hill contains 2 grains, and pebbles in the Liffey, at "Bogey's Castle," as much; other rocks only a trace, or none.

[**609.**] **Paxon, H. C.**—Gold Mining in Merionethshire.

Paper read to the Institute of Civil and Mechanical Engineers on March 19, but not published in 1890.

[**610.**] **Rose, T. K.**—The Extraction of Gold.

Paper read to the London Amateur Scientific Society on Dec. 12, but not published in 1890.

611. Postlethwaite, J.—The Borrowdale Plumbago: its Mode of Occurrence, and Probable Origin.

Abstract in Proc. Geol. Soc., p. 124.

It occurs "in veins traversing diabase and diorite," and in "sops" or pipes, and was formed, he thinks, under conditions more closely approaching those which gave rise to the Kimberley Diamonds than to those which originated the graphitic deposits in North America. He appears to think it came from below, on the volatilization of carbonaceous matter by the ascending igneous rock.

[**612.**] **Rigby, J. S.**—The Mineral Phosphates of South Carolina.

Paper read to the Liverpool Polytechnic Society on Feb. 24.

COAL.

613. Smyth, Sir W. W.—Coals and Coal Mining.

London, 8vo, new edition.

614. Burrows, J. S.—Notes on Coal Mining.

Trans. Manchester Geol. Soc., vol. xxi., p. 48.

This is entirely confined to the mechanical side of the subject.

615. Streatfield, H. S.—Durham Coal Mining.

Proc. London Amateur Scientific Soc., vol. i., p. 28.

Gives a general account of the working of a mine and of the products obtained.

616. Hull, E.—Our Coal Resources.

Trans. Edinburgh Geol. Soc., vol. vi., p. 76.

He still inclines to think his original estimate of 83,544 million tons for the total available coal in Great Britain is nearer the mark than the Coal Commissioners' estimate of 136,000 millions, but the rise in production has been very rapid since 1860 in all coal-fields except the Forest of Dean, Coalbrook Dale, Flintshire, and Leicestershire.

He does not think that there is any prospect of exhaustion in the near future, but the average depth at which it is got will continually increase, and its price will rise till waste and extravagance are stopped.

617. Cadell, H. M.—Notes on the Coal Question.

Trans. Edinburgh Geol. Soc., vol. vi., p. 86.

This merely says that high prices are an advantage by tending to produce economy, and that when coal begins to run low other sources of energy will be made use of as well as coal.

618. Chisholm, G. G.—An Examination of the Coal and Iron Production of the Principal Coal and Iron produc-

ing Countries of the World with Reference to the English Coal Question.

Journal Statistical Society, vol. liii., p. 561.

The last year for which the information is complete is 1887. The numbers are given in thousands of tons:—

New South Wales, 2,923; New Zealand, 559; Austria Hungary, Coal 8,583, Lignite 13,297; Belgium 18,375; Canada, 2,159; France, 21,288; Germany, Coal 60,334, Lignite 15,899; India, 1,560; Japan, 1,492; Russia, 4,448; Spain, 1,038; United Kingdom, 162,120; United States, Anthracite 37,579, Bituminous 78,471.

The rate of increase from 1880-1887 per cent. has been:—

Austria Hungary, Coal 3·86, Lignite 5·24; Belgium, 1·56; Canada, 8·22; France, 1·81; Germany, Coal 4·19, Lignite 4·04; Japan, 9·09; New South Wales, 9·30; New Zealand, 11·93; United Kingdom, 1·71; United States, Anthracite 4·14, Bituminous Coal 9·39.

The complete information for 1886 as to the production of Iron Ore gives:—

Algeria, 433; Belgium, 153; France, 2,286; Germany, 8,486; Italy, 209; Spain, 4,167; United Kingdom, 14,110.

BUILDING AND ROAD STONES.

619. Wilding, J.—The Building Stones used in Liverpool.

Journ. Liverpool Geol. Assoc., vol. ix., p. 25.

The dock walls are made of Granite from Dalmore, Sutherlandshire, and partly from that of the Ross of Mull. Shap Granite is used in Palace Chambers. The Carboniferous Limestone is used for basement courses in Riley's warehouses. Of the Coal Measure Sandstones, Longridge Stone, from near Preston, is used in the New Exchange Station Buildings. Minera Stone, from Pen-y-Gelli, Denbighshire, at the Wholesale Fish Market, Salvage Stations, and St. John's Market. Bolton Wood Stone, from Bradford, is used in the interior of the Rotunda. Talacre Stone, from Holywell, is used in the Huskisson Mausoleum, St. James' Cemetery. Mansfield Dolomite is used in Mr. Noblett's Warehouse. Trias Sandstone is very extensively used, it is of three colours, the red is from Everton, Woolton, Runcorn, and Rainhill, and is used in Sailors' Home, "Daily Post" Offices, Picton Reading Rooms, and St. Silas'. The white, from Storeton, at Owen Owens, Don Association, Custom House, Exchange Hotel, Conservative Club, and Exchange Buildings. The yellow, from Old Park Quarries, in Great George Street

Chapel, and St. Paul's. The Cefn Stone, from near Ruabon, is used in the Walker Art Gallery, the Picton Reading Room, Central Buildings, and Lewis's. The Cathedral is built of Trias Sandstone. The Woolton Stone is the hardest, and Everton Stone is much used in "jerry" buildings. Much of the Runcorn Stone is sent to America. A Sandstone from Corschill, Annan, is used in the Queen's Insurance Buildings. Hollington Stone is used in the Exchange Buildings. Bath Stone is only used for exteriors at the Unitarian Church, Hope Street, and at St. Chrysostom's. The Ancaster Stone is used in the Central Station, and New County Sessions Court, Islington. The only Portland Stone of any note is in the New Law Courts. The Bank of Liverpool is built of some Yorkshire Stone.

620. Wilding, J.—The Sandstones used in Birkenhead Priory.

Journ. Liverpool Geol. Assoc., vol. ix., p. 59.

Probably Bunter from Tranmere and Storeton Stone.

621. Anon.—Yorkshire Stone.

"Builder," vol. lviii., pp. 221, 277.

These articles are chiefly occupied with the method of getting. The latter one gives some geological details. A section of Yew Tree quarry, Lightcliffe, shows three beds of flagstone, separated by rag and capped by ashlar, in 12½ yds., overlaid by 13½ yds. of rag and shale. The quarries are found in a semi-circle to the east of Halifax. The following are the names:—Northowram, 9; Hipperholme, 5; Lightcliffe (Hill Top), 13; Lightcliffe (Harley Head), 3; Southowram, 14; Brighouse (Lane Head), 4; Brighouse (Lightcliffe Road), 6; Rastrick, 8; Elland Lower Edge, 4; Elland Upper Edge, 10; Barkisland, 3.

The weight and strength of this stone has been compared with various others.

	Weight per cubic foot in lbs.	Crushing weight in tons per sq. ft.
Aberdeen granite	166	534
Cragleith sandstone	146	505
Portland stone	137	276
Bath stone	123	216
Patent Victoria stone	—	415
Yorkshire Park Quarry, Northowram	155	715
Yorkshire Yew Tree Quarry, Lightcliffe	150	699

622. Anon.—[Analysis of Bath Oolite Stone].

"Builder," vol. lix., p. 324.

Water	·14
Loss on ignition	1·60
Oxide of iron	·79
Alumina	·26
Lime	55·13

Magnesia	·36
Alkalis	·47
Carbonic acid, &c.	40·72
Chlorine	·03
Silica	·50
	100·00

623. Bateman, J.—The Roadstones of Somerset and Wilts.

Transactions Civil and Mech. Eng. for 1888-9 (pub. Jan., 1890), p. 76.

The stones mentioned are the Carboniferous Limestone, Basalt, Dolomite, and Flints, but nothing of geological interest is stated.

624. Shore, T. W.—The Clays of Hampshire and their Economic Uses.

Hampshire Field Club, Proc. No. 4, p. 23, pl. i. and ii.

The Bracklesham clays contain crystals of selenite (figured), also clay ironstone and vivianite, where acted on by decomposing organic matter, as below Netley shoal, and the Lower Bagshot contains septaria at Bittern. Alum occurs in water from a well at Southbourne-on-Sea. Glauconite in the green sandy loams. The author gives a brief account of the various clays from the Wealden to Recent. Every subdivision except Upper Bagshot, Chalk, and Upper Greensand has been used economically.

WATER SUPPLY.

625. De Rance, C. E.—Fifteenth Report of the Committee on Underground Waters.

Rep. Brit. Ass. for 1889, p. 71.

This consists of details of the strata passed through, and other information on various wells in the Trias and Permian at the following places:—Teignmouth; Burcot, Worcestershire; Charford, near Bromsgrove; Leicester (3 wells); Bourn, Lincolnshire; Liverpool; Halewood, Cheshire; Prescot; Gateacre, Kirby and Knowsley, near St. Helens; Greatham, Durham; and Seaton Carew. Appendices are given on Hertfordshire chalk wells and Borings in the Tertiaries of the Hampshire Basin from previously published works.

626. De Rance, C. E.—Notes on Underground Water Supply and River Floods.

Proc. Yorks. Geol. and Polyt. Soc., New Ser., vol. xi., p. 200.

A general paper on the subject, without new information.

627. Grantham, R. F.—Notes on Water Supply.

Trans. Sanitary Inst., vol. x., p. 222.

A general discussion of various points, not particularly of geological interest.

628. Fordham, H. G.—A Record of Water-level in a Deep Chalk Well, at Odsey Grange, Royston, 1878—1888.

Trans. Hert. Nat. Hist. Soc., vol. vi., pt. i., p. 31; and pt. ii., p. 33. Plates i. and ii.

The depth of water in the above well has been daily gauged for nearly ten years and compared with the records of two neighbouring wells at Therfield and Baily. Plate i. gives the diagrams of these wells, showing the heights of their tops and bottoms, and the position of the nearest springs. The zone of constant water is about 150 ft. above ordnance datum, and is pretty level from the springs to Odsey and Baily, but rises to about 230 ft. in the Therfield well. The zone of variable water is represented as 44 ft. deep at Odsey, 78 ft. at Baily, and 64 ft. at Therfield. The actual ranges of the wells are at Therfield, 506 ft. to 230 ft.; at Baily, 305 ft. to 140 ft.; at Odsey, 265 ft. to 161 ft. Plate ii. is a graphic representation by months of: 1. The rainfall in inches at Odsey for the month by vertical lines. 2. The water level in feet, reckoned from the bottom of the three wells, by curves, abscissæ being time and ordinates depth of water 20 ft. to the inch. Two tables are also given derived from this. The water is found to be at a maximum about February, but there are notable variations. The only deductions he draws from the curves are as follows:—"The movements of the water are slightly later in time in the deeper wells on the higher ground at Therfield and Baily than at Odsey, while at the same time a close parallelism is maintained in the curves, representing the changes of level in the three wells. The rise from November to March, and the subsequent fall, take place, with more or less modification, from the mean curve year by year, any abnormal development in the annual curve being generally associated with some exceptional condition relative to the autumn and winter rainfall, and but rarely to that of the spring or summer." [Nevertheless, the teaching of this valuable table is very far from exhausted. It shows a much greater depth of water in the wells from 1879 to 1883 than in later years. The maxima and minima at Baily and Odsey coincide, but, on an average, the Therfield well is about two months behind, and the water is about 120 ft. lower from the surface, showing the rate of percolation. Again, it is a remarkable circumstance that a few inches of rainfall give many feet of rise in the water of the wells. This, if worked out, should give us an estimate of the amount of spare room in the chalk ready to contain water. In one case, 3½ ins. of extra rain raised the water

40 ft., showing the chalk to contain about $\frac{1}{120}$ of its volume of *available* water, *i.e.*, of water filling the spaces from which it will flow out underground. It is noticed also that, whereas the difference in heights of the water at Baily and Odsey (as marked in the chart) is 30 ft. on the average when the water was higher (1879—83), it is not more than 20 ft. when the water was lower; and the same between Odsey and Therfield, giving us some approximation to the amount of evaporation.]

629. Holmes, T. V.—Chelmsford Water Supply.

"Essex Naturalist," vol. iv., p. 82.

The London Clay is nearly flat. It is overlaid by glacial sand and gravel, and this by Boulder Clay; the latter is often thin and absent, and the water is obtained from the underlying gravels.

630. Gill, J. C.—Artesian Wells in South Lincolnshire.

Proc. Inst. Civil Eng., vol. ci., pt. 3.

Gives an account of a well at Willsthorpe, Lincolnshire, 63 ft. deep. The first 5 ft. in superficial deposits, then a 1 ft. bed of Peat, a 1 ft. bed of Marine Shells [? oolitic], and then undescribed limestone and rock. The water has risen very freely to 52 ft. above O.D., and has continued at this level.

[**631.**] **De Rance, C. E.**—Sixteenth Report of the Committee for Investigating the Circulation of Underground Waters.

Read to the British Association in September, but not printed in 1890.

MINERAL WATERS.

632. Bell, Thos.—On the Middlesbrough Salt Works and the recent Boring on the Lackenby Foreshore Estate.

Trans. Manchester Geol. Soc., vol. xx., p. 555.

The last borehole put down is near Lackenby, "at a distance of $1\frac{1}{8}$ miles, a little to the north and east of the South Bank boring and to the full dip of the measures." It has been executed by chopping, which does not bring up cores. Though so near the Lias at Redcar, it does not begin in Lias but in red clay; after the surface alluvium the section was—

	ft.	in.
Clay and Gravel	13	0
Hard Red Clay and Gypsum	11	8
Red Marl and thin rock	62	4
Red Marl and bed of Blue Marl ..	159	8
Bed of very hard rock	8	4

Blue and Red Marl	88	0	
Dark Red Marl and Bluestone	30	0	
Hard Bluestone	7	0	
Red Marl	217	0	
Red Sandstone	598	0	
Red Marl	77	0	
Red Marl and Sandstone beds	371	0	
Hard white rock	20	0	Anhydrite beds.
Honeycomb rock	9	0	
Salt and Marl mixed	13	0	
Clean rock salt	119	0	
White rock	2	0	+
	1,806	0	

[No suggestion is given as to what part of the Trias or Permian any of these beds may belong to.]

[**633.**] **Marley, J.**—On the South Durham Salt Field.

Paper read to the N. of Eng. Inst. of Min. and Mech. Eng. on Aug. 2, but not published in 1890.

[**634.**] **Bothamley, C. H.**—The Sulphur Waters of Harrogate.

Paper read to the British Association on Sept. 6, but not published in 1890.

MAPS AND SECTIONS.

ENGLISH MAPS.

635. Sheet 92, N.E. (New Series, Sheet 61.)—Issued in 1890 (though bearing date 1889).

This shows part of the courses of the rivers Nidd and Wharfe, having Pateley Bridge to the N.E. Two different indices are given for the two sides of the map, which indicate that the Carboniferous Limestone series (which is not called Yoredale beds), is thicker in the S.W. by the intercalation of a quantity of shale, the upper band of which is called the Bowland Shale, and the limestone band below it is called the Pendleside Limestone. In the north and east the overlying Millstone Grit series is divided up into numerous bands by beds of shale, so that 11 sandstones and a shell bed are separated; while on the other side the sandstones are more massive. In the south-west the lowest variable series of sandstones and shales is called the Pendle Grit, and those above are the Kinder Scout Grits. On the east side the three lowest sandstones are called Kinder Scout Grits, and the 6th to the 9th the Burnham Grits, the rest being unnamed.

The beds must have a gentle dip to the east, as the geological lines approximate to the contours, but on the western side two long tongues of Carboniferous Limestone stretch towards the centre. The shell bed makes a conspicuous feature on the sloping sides of the Nidd and the higher grounds north and south of it below Pateley Bridge. In the extreme north-east an unconformable patch of Magnesian Limestone is marked. Lead veins are numerous in and near the Carboniferous Limestone.

636. Sheet 97, S.W. (New Series, 50.)—"Solid" and "Drift" edition.

This comprises Whernside, Ingleborough, Penygent, and Widdall Fell, with the country to the east and north as far as Wensley Dale. The following are the sub-divisions shown in the solid Geology:—Middle Coal Measures, with Four-foot or Main Coal and Deep Coal forming their base, with Lower Coal Measures below; Millstone Grit, with four persistent bands of sandstone, and a lower one called Ingleborough Grit, which dies away. The Yoredale Rocks are separated as Main Limestone, Grit, Underset Limestone, Five-yards Limestone, Middle or Scar Limestone, Simonstone Limestone, and Hardraw Scar Limestone, each with intervening shale. Below are the Great Scar Limestone and Red Conglomerate Basement Beds. The Upper Silurian Rocks are Coniston Grit and Coniston Flags, which are parallel with Denbighshire Grits and Flags. The Lower Silurian, *i.e.*, Coniston Limestone = Bala Beds and Grits and Slates "b_2." There is a Mica Trap Dyke in the latter near Ingleton. The Silurian Rocks are represented in three separate places in valleys, viz.: round Horton, in Ribblesdale; in Dale Beck, Ingleton; and below Dent. They are all small, and the sub-divisions irregularly placed. The Basement beds are shown in very minute patches in the same localities. The rest of the map presents a curious aspect, with the ribbon-like bands of different tints of blue following almost exactly the contour lines. The Millstone Grit beds lie only in 15 outliers at the tops of the various hills, the only one that shows them all being called Buckden Out Moor, on the eastern side. The Drift edition only differs in the valleys being largely filled with the tint representing Boulder Drift.

637. Sheet 106, N.W. (N. S. 12.)—Solid and Drift Editions.

This is part of the north-west coast, the only village shown being Kirkcambeck. The high ground is called Bewcastle Fells. The strata shown are the Carboniferous Limestone series "d_1" and "d_2," with thin bands of limestone and cement stones. These are in minute patches and

bands, scattered apparently without any order through the Shales and Sandstones, Coals and Ironstones. The bands of coal are equally minute and very few, the largest being the Netherhill Seam, 1 ft. 2 in. thick. There are also parallel bands in two localities of contemporaneous basalt and ash. Towards the south-west corner comes on, with an undetermined boundary, some Kirklington Sandstone and St. Bees Sandstone, and thin Conglomerate belonging to the Trias. A broken whin dyke crosses the north, running east-north-east. If the several parts were once united, the country must have been very broken up since that date. The Drift edition shows the Boulder Clay rising to 1,238 ft. on Cammock Rigg, but the higher parts up to 1,664 ft. on Glenddu Hill are covered by Mountain Peat.

The coal is worked in the discontinuous patches along the coast, where it lies in the "Penton Coal Basin," served by the North British Railway. A section of this is given.

	ft.	in.
Alluvial Cover, &c.	3	17
Upper Coal	2	3
Strata	15	0
Middle Coal	1	8
Black Stone	1	8
Coal	1	10
Strata	84	0
Lowest Coal	1	6
Stone and Coal	1	2

637a. Sheet 108, S.E. (N. S. 8.)—Solid and Drift Editions.

The River Rede runs through the centre. The rocks shown are principally the Carboniferous Limestone series, which are classed in three divisions. The "Calcareous division" comprises eleven bands of limestone and two of coal; three have local names. The Carbonaceous division consists of Sandstones and Shales, Calcareous Grits, Plant Limestones, and some Encrinital Limestones and Coal Seams. The Tweedian division is separated into Fell Sandstones, or Upper Tweedian beds, described as thick beds of Grit and Sandstone, with Shales and Red Clays, and some thin bands of fine Conglomerate; Rothbury Limestones, described as Grey and Greenish Shales, Flaggy Sandstones, Cement Stones, and Limestones (?), poor in fossils; and Lower Freestones, consisting of Sandstones and coloured clays, with pebbly base. According to the scale these have a thickness of over 5,000 ft. The sub-divisions are not mapped, but merely the individual limestones all by one colour. Below all this is Basement Carboniferous (or Upper Old Red Sandstone?), Lower Old Red Sandstone, and Upper Silurian (Wenlock). None of these latter make much show on the map, occurring only in the north-west corner,

where also is seen contemporaneous basalt, Porphyrite of Old Red Sandstone age, and a neck of intrusive basalt. There is a broken whin dyke crossing the country east and west. The Drift edition shows the Boulder Clay up to 1,250 ft., but the highest summits up to 1,809 ft. are covered with Hill Peat.

SCOTCH MAPS.

638. Sheet 16.

In this map Moffat lies in about the centre of the south-west quarter.

The main rocks are all called "Silurian" simply. They are classified as follows:—

Wenlock ..	Greywacke, Shale, and Graptolite Shale ..	"b_6."
Llandovery	Flaggy Greywacke and Shale, Hawick beds Grits, and occasional Shale bands, Queensberry Grits Pebbly Grit and Conglomerate, Haggis Rock Greywacke and Shale, Grieston Shale and Abbotsford Flags Black Shale, Birkhill, iii.	"b_5" and "b_4."
Caradoc	Shale, Mudstones, &c., Lowther Shale and Barren Mudstones Fossiliferous Grit and Conglomerate, Wrae, Kilbuchs and Leadhills Greywacke and Shale Black Shale, Hartfell ii. Greywacke, Shale and Chert	"b_3."
Llandeilo	Black Shale, Glenkiln i. Greywacke and Shale.	"b_2."

Of these groups the great mass of the map is occupied by the Llandovery, "b_4"—"b_5." The general trend of the rocks is north-east, and in accordance with this the Caradoc and Llandeilo occur only in the north-west corner, the Wenlock only in the extreme south-east; so that there is a certain amount of regular sequence in the beds. Nevertheless, the rocks are said to be "much deformed and cleaved along the line of strike." The Black Shales are represented by dark lines, which in every case join together at the two ends, and enclose a lenticular space. They must, therefore, be local along the line of strike, and are also thrown into sharp anticlinals and synclinals. In the region which runs north-easterly from the Annan Valley, parallel to and south-east of Moffat Water, are four parallel anticlinals crowded together in a space less than two miles across, and having a more than ordinary continuance along the strike. One of the folds is called "compound synclinal of Queensberry Grits," and the neigh-

bouring band a "compound anticlinal of black shales." The outer band of the lenticle is marked as the Birkhill Shales, the next inner parallel band the Hartfell, and a single shorter central line is the Glenkiln. Thus these lower shales are represented as being brought in as inliers by the foldings of the rock and the denudation of the surface. While the lenticles bounded by Birkhill Shales are innumerable, those in which the others occur number only 22, and in only five of these are found the Glenkiln. To find the two lower shales in bulk we have to go to the north-west corner of the map, in the extreme point of which the deep anticlinals bring up the Glenkiln Shales, with contemporaneous basic lavas, and tuffs and agglomerates at the base. In one or two places only, reversed faults are marked with yellow lines.

The Permian rocks are confined to the slopes and base of the Annan Valley [which must therefore be pre-Permian in origin]. They consist of breccia at the base and sandstone at the top, found only on the higher ground at the head of the valley.

Long narrow basalt dykes cross the western side in a south-east direction, cutting across hill and dale. There are sporadic short felsite dykes, and one of minette on the eastern border.

639. Sheet 94.

This includes about 4 miles of the land east of Moray Firth and as far north as Tarbet Ness. The rocks shown are classed as metamorphic, Old Red Sandstone and Jurassic. The first include granitic gneiss "α'," quartzose micaceous schist or gneiss "α," quartzite "x" (in S.E. corner only), and hornblende rock "q." The granitic gneiss forms the two Sutors of Cromarty and part of the coast further S.W. The schist forms the extreme N.W. corner, only just included in this map, where it is separated from the Old Red Sandstone by a great boundary fault. The others are minute masses, like dykes, in the above, as is also the only igneous rock coloured, a microgranite. The Old Red Sandstone which occupies the bulk of the map is divided into Lower "c_1" and Upper "c_3." The former contains near the top a pebble bed, near the middle a band of "Fish Beds and Psilophyton Shales," and at the bottom basement breccia and conglomerate. The basal conglomerate is seen north of the North Sutor on the coast, the other beds further along this coast and S.W. of Tain. The Upper Old Red Sandstone is only shown on the ground east of the Moray Firth, and in a triangle between Tain and Tarbet Ness. It appears to have been only really seen at the latter spot on the sea coast, where it consists of "Pebbly grits and gritty sandstones identical with the Holoptychian Sandstones of Dornoch";

on the west side, at Roys Bay, it is "Red and yellow current-bedded sandstones, zones of flaggy sandstones with Ichnites." The direction of the dip in these beds is exactly the same as that of the lower beds, but the angles are higher. The line of junction is marked as "uncertain" but "unconformable."

The Jurassic rocks "g" are undivided; they occur only on the east side of a fault which runs along the N.W. side of Moray Firth and here and there just enters the land; they form exceedingly narrow and short patches.

Glacial striæ are marked, but they are extremely few in number, noted only at Shandwick Bay, on the W. side of Moray Firth, and up the Dornoch Firth. The 15 ft., 25 ft., 50 ft., and 100 ft. raised beaches are marked which join the Dornoch and Cromarty Firths to the west of the Sutors and Tarbet Ness, and let the sea in between these two at Shandwick Bay. Freshwater terraces are also marked.

640. Sheet 114.

This map gives the results of the geological survey in the Eirebol and Durness district, and this being a very critical area for general theories, it is of the highest importance, and would require a long paper to discuss all the points which it brings out. The rocks are classed under three heads—Igneous rocks (Intrusive), Metamorphic rocks, Sedimentary and Sub-aerial rocks. The principal portion consists of the Metamorphic group. These are first divided into Archæan and Younger Schists (Palæozoic) of Palæozoic age, derived from Archæan and Palæozoic rocks. The former of these is undivided. It is almost entirely confined to the country west of Loch Eirebol, where its antiquity is demonstrated by basal beds of the Torridon Sandstone lying upon it, the only other places being a patch near Craig na Faolin and one north-east of Loch Hope (A). The other metamorphic group is divided into "Thrust Archæan Gneiss, with old structures not wholly obliterated, A'," "Crush Rocks and Frilled Schist (Fragmental structures not obliterated)," with "Schistose Marble, g," "Quartz Schist, x," "Moine Schist, Micaceous Gneiss and Quartzose Flagstones, holocrystalline, α," with "Garnetiferous bands," "Hornblende Gneiss or Schist, sometimes with Biotite or Muscovite, α'," "Amphibolite, q."

"A'" is not found west of Eirebol, except in Sango Bay and the west side of Fair Aird. In the latter it is represented as limited by a thrust plane, and in the former by an ordinary line. It is principally seen at Whitenhead, where it is limited on *both* sides by a thrust plane; on Arnaboll, where thrust planes bound it all round, except on the west, where the strata are inverted; and other patches along the eastern side of Eirebol Valley; also a large patch east of

Tongue, having very irregular boundaries like an igneous rock, and no thrust planes.

"g" is entirely confined to the east side of Loch Eirebol, Sango Bay, and Fair Aird. In the former locality there is a broad band of it, the north part of which is bounded on both sides by thrust planes. Near Loch Hope it contains bands of quartz schist, and further south there are narrow bands of quartz schist next the gneiss, and then a narrow band of schistose marble, and then the bulk of "g." [If the mechanical stresses have not obliterated the stratification of the quartz and marble—as seen by their running on the map—why should it have done so in the frilled schist, which, if in its proper order of sequence, should lie *above* the limestones?] The patch of unthrust Archæan lies on this. At Sango Bay no less than four major thrusts and eight faults are brought in in connection with this and the limestone. [This is the only place where the highest beds of the limestone appear; and it is here, according to the observation of the writer of this book, that this limestone is succeeded naturally by shales.] At Fair Aird the thrust Archæan is followed by schistose limestone, and then by the frilled schist. The position of these masses is explained by two curved faults uniting in Sango Bay, both with a downthrow on the north, which have let down portions of the great Eirebol thrust plane, which is on the rise westwards.

"a" is the widest spread mass, but with the exception of Fair Aird is confined to the east side of Eirebol. The garnetiferous bands and amphibolite are in narrow irregular streaks running in various directions. "a'" is almost entirely confined to the eastern side of the Kyle of Tongue.

The sedimentary series are divided into "Torridon Sandstone, Cambrian?" in three divisions—"basement conglomerate, middle and upper a' a'' a'''"; "Lower or arenaceous division," consisting of quartzite separated as Basal Breccia, False-bedded Grit, and Pipe Rock; "Middle or Intermediate division," divided into Fucoid Beds and Serpulite Grit, and "Upper or Calcareous division," consisting of Durness-Eirebol Limestone divided into seven parts, which in ascending order are called Grudio, Eilean Dubh, Sailmor, Songomore, Balnakiel, Craspuil, and Durine. The Torridon Sandstone is found on the hills to the west dipping down to the Durness Road, and is let down to the seaside north of one of the faults. It is overlaid by the quartzite.

The quartzite surrounds L. Eirebol, and is at the head of the Durness Valley. It has been subjected to 16 minor thrusts by Conambeall, and with the overlying beds has been made into a mass of slices north of Heilim Inn.

[The Fucoid and Serpulite beds may be taken at the base of the limestones which they everywhere accompany.] Only the two lower bands of the limestone occur in Eirebol, and all but the highest on the east side of the Durness Valley, one regularly overlying the other, but it is only between the two faults already mentioned that the highest bed is preserved.

The isolated patches of coarse breccia conglomerate to the east of Tongue seen at Cnoc Craigie, Cnoc au Fhreiciedain, and the Island of Nanson are marked as Lower Old Red Sandstone.

The igneous rocks mapped are the granite of Ben Laoghal, with associated felsites, minute short dykes of basalt in the Moine Schist, diorite, and palæopicrite bands in the schists and thrust gneiss east of Tongue, and a patch of serpentine north-east of Loch Hope.

Major thrusts are marked by green lines. They are entirely confined to the district within two miles east of Loch Eirebol and its continuation towards the south, with the exception of two parallel ones on Fair Aird, and quite a collection of minute ones between faults in Sango Bay.

Minor Thrusts are marked by deep black lines, which occur only at Whitenhead, north of Heilim Inn, and in the S.W. continuation of the line of Loch Eirebol. [One cannot help seeing from this map what a feeble show these make compared with the whole country surveyed.] Glacial striæ are marked which trend on the whole parallel to the valleys of Eirebol and Tongue. They are most numerous on the high ground west of the former, where they are rather irregular, and a glacial terrace is marked in the valley next east from Tongue.

IRISH MAPS.

641. Sheet 4.

Shows Horn Head, Sheep Haven, and country to East.

The main rocks are called "Metamorphic rocks," and are distinguished as "q. quartzite," "μ mica schist," "λ limestone," "δ dolomite." These are very much broken about. The quartzite is massive, as is the schist, but the limestone is mostly in bands in the latter. The serpentine is in a very small patch near Dunfanagby, and in a few thin bands. Amongst these, masses of dolerite run in a very irregular way, in many places metamorphosed into epidiorite, and there are also equally irregular masses of granite, only on the north side of a fault on the east side of Sheep's Haven. There are also some narrow felsite dykes.

Glacial striæ are marked. There are very few on the north coast, the flow being marked as to the north.

642. Sheet 5.

The rocks are quartzite, mica schist, limestone, and dolomite, with basalt, felstone, felstone porphyry, granite, and epidiorite. Granite forms Fanad head and promontories S.E. of Dunaff. The rest consists of broad bands of quartzite and schist, those to the N.W. the broadest. These run, with sharply drawn, nearly straight boundaries, E.N.E., and the narrower bands of limestone and epidiorite run with equally straight boundaries in the same direction. Glacial striæ are marked, and also the raised beaches.

643. Sheet 10.

This country lies south and west of Mulroy Bay.

The rocks shown are "q quartzite and quartz schist," "μ gneiss and mica schist and grits," "λ crystalline limestone," "δ dolomite and steatite," "Δ diorite passing into hornblende schist." All these are called "metamorphic rocks." There are also "G. granite" and "Gf. ditto when foliated," felstones, diorite, and basalt.

The country may be said to be dominated by a broad area of granite, which runs along the centre in an E.N.E. direction. On either side of this comes a band of schists, a band of quartzite, and another band of schist. The quartzite is irregular, and an additional mass of it bounds the granite on the W.N.W. side. The granite is greatly foliated parallel to the band, and on either side, especially on the northern, the bands of limestone and hornblende schist are drawn out in long tongues. They run in the same way on the S.E. side of the second mass of quartzite. The additional mass of quartzite is nearly surrounded by a band of limestone, between which and the quartzite the dolomite, &c., comes in. The diorite (*i.e.*, unfoliated) is in irregular patches at some distance from the granite, and is in considerable quantities beyond the N.W. mass of quartzite, all of which and the schists beyond are spread out more irregularly, and contain a large mass of limestone. The dykes marked basalt are obviously of later date, as they cross the granite at right angles to its foliation.

644. Sheet 15.

This is the continuation to the west of the Sheet 16. The rocks are mica schist, limestone, and quartzite. The greater part is granite, strongly foliated towards the south-east. There is an isolated mass of granite south of Gweebarra Bay, and between these the schists, limestones, and diorites are pulled out into long curved bands. There are three masses of quartzite, one in the north-west, one in the promontory north of Gweebarra Bay, and one in the south-east, forming Agla Mountain.

645. Sheet 16.

This contains "q quartzite," "μ mica schist," "μr ditto, passing into gneiss," "λ limestone," and "δ dolomite," "Δ Hornblende rock passing into schist;" all called metamorphic rocks.

The igneous rocks are in six varieties, basalt with dolerite, diorite with epidiorite, felstone, felstone porphyry, elvanite or quartz porphyry, and granite. At the north-west is a mass of granite foliated E.N.E., and crossed by dykes. On the south-east side are masses of quartz, diorite, and limestone, so far as uncovered by peat, drawn out in the same direction; but all of them as isolated masses in schist. Further south-east the schist predominates over the whole country, but in the south-east corner broad spreads of quartzite and limestone are irregularly developed A fossil locality is indicated.

646. Sheet 22.

This contains the promontory round Glenbay.

The rocks are "μ mica schist," "q quartzite, and siliceous schist," "λ limestone," "Δ diorite and epidiorite." *Each* of these, except the last, is marked as containing pebble beds, or conglomerates.

The distribution is very irregular. The mica schists lie more in the valleys, and the quartzites form the highest grounds, but yet reach the sea both north and south. The dips are in various directions. The limestone is only in small patches and bands, and the epidiorite an irregular long mass. There are two small patches of carboniferous sandstone and conglomerate on the top of a cliff to the south. The igneous rocks are in minute streaks, and Rathlin O'Birne Island is of felstone porphyry.

647. Sheet 23.—(Said to be published in 1889 (Dec.).)

This has Loughros More Bay in the north-west corner. The rocks are Metamorphic and Carboniferous. The former are divided into "q Quartzite," "λ Limestone," "μ Mica-schist with pebbly beds," "Δ Diorite passing into schist." These occupy the greater part of the map, except a large south-east corner. North-west of Ardara and Glenties there is a mass of granite foliated parallel to its edges, and round this the other rocks pass, spreading out in the south-west. The schists are most abundant. The quartzite and diorite come next, in very irregular masses showing no general orientation. The limestone is confined to narrow and short bands, which are not very numerous. The Carboniferous rocks are divided into "d2 Calp Shale and Sandstone," "d2′ Lower Carboniferous Limestone," and "d′ Lower Carboniferous Shale and Sandstone." The limestone is confined to a band half a mile in width, and running N.N.E., about four miles from

the south centre. The other two succeed in order on the older rocks; a mica trap occurs at Loughros Point, and about half the country is covered with peat. The glacial striæ are marked, some parallel to present contours.

648. Sheet 30.

This is only a minute corner of the map, with irregular quartzites, mica schist and gneiss, and hornblende rock. A piece of Carboniferous Limestone is faulted down to form Muckros Head.

HORIZONTAL SECTIONS.

649. Ireland, Sheet 29.

This illustrates the One-inch Maps, Nos. 14, 20, 28, 29; and the Six-inch Maps, Nos. 14, 19, 20, 25, 29, 34, 39, 40, 46, 52.

The section runs from Carrickfergus, in a N.N.W. direction, to Fairhead and Rathlin Island, by Agnews Hill, Glenarm, Glenariff, Lurigethan Mountain, Cushendall, and Glendun. Carrickfergus is built on a great mass of Basalt, as a neck or dyke in the midst of "Red Keuper Marls, with rock salt and thin bands of gypsum." This rock salt is worked at Duncrue, where the section is:—

	ft.	in.
Drift	50	0
Red Marl and Gypsum	500	0
Rock Salt, 1st bed	15	0
Salt and blue band	6	0
Rock Salt (pure), 2nd bed	88	0
Blue and red band, with some salt	17	0
Mixed Salt and blue and red band	13	0
Rock Salt (pure), 3rd bed	39	0
Thin blue bands	6	6
Dark coloured rock	4	0
Freestone	10	1
Grey rock	2	0+

On the rise to Tappin Mountain are seen thin bands of Rhætic, Upper Greensand, and Upper Chalk, which are continued below, and over all is a great thickness of Lower Basalt with a dyke or two.

In the valley to the north, where the direction changes to N. 23° W., is a basin of Pisolitic iron ore and Upper Basalt, but the Lower Basalt comes on again at the Ballymena and Larne Railway. At Head Wood a fault brings up the Trias and Chalk again, and the Pisolitic iron ore and Upper Basalt is thrown to the flat top of Agnews Hill, where it goes on almost continuously to Skeagh. Beyond comes a large "Intrusive dyke-like mass of dolerite rich in olivine," on the other side of which the basalts continue and are faulted up·

again near the edge of map 20 (1 in.), and so it goes on to Glenariff Valley, on the slopes of which the Chalk and Greensand lie on the Keuper. Lurigethan Mountain is capped by the Lower Basalt, and on its N. 20° W. side is a mass of felstone porphyry at the base, which is bounded by a reversed fault, bringing in "Red and purple sandstones and massive conglomerate," dipping towards the hill and called "Lower Old Red Sandstone or Dingle Beds." These lie on a mass of the "grey micaceous and chloritic schists with vein quartz," called "metamorphic rocks." This continues in Sheet 30, as below.

650. Ireland, Sheet 30.

This illustrates the One-inch maps Nos. 8, 13, 14, and the Six-inch maps Nos. 5, 9, 13, 14, 18.

It commences at Glendun River, over Crockaneel Mountain, to Coolnagopogge. All this is represented as contorted "grey, green, and brown micaceous chloritic and hornblendic schists," except a patch about one mile long, where there is a thin covering of Greensand and Upper Chalk overlaid by a Lower Basalt. The continuation runs to Fair Head, about a mile from which the schists wedge down to datum, and are replaced by an upper wedge of "Carboniferous Sandstone, shales, coal seams, ironstone (Blackband), and a limestone bed with a conglomerate at the base." This is capped by "massive columnar dolerite and basalt, which also intrudes into the Carboniferous rocks [very like Salisbury Crag, Edinburgh].

Boulder drift is shown on the gneiss.

Another section runs S. 20° E. to N. 20° W. Rathlin Island shows a faulted synclinal of chalk with flint in the centre about Mill Bay, capped by thick sheets of basalt—Lower and Upper. Iron ore is found at the base and in the middle of the latter.

A third section runs S. to N. and S. 17° E. to N. 17° W. from a point three miles S.S.W. of Armory, by Knocklayd Mountain, to the coast at Portnagee Colliery, south-west of Fair Head. Knocklayd is the highest point, on a basis of schists, as above. It is capped by a thin bed of chalk with a greensand pebble bed at the base; over that is Lower Basalt with Pisolitic iron ore, and the rest is Upper Basalt (with three dykes). These are all nearly horizontal. The gneiss dies out very gradually to the S. 39° W. end, and on the slope come thin beds of Keuper, Upper Greensand, very thin, and Chalk with flints, all capped by Lower Basalt on an eroded surface. At the other N. 39° E. end, the gneiss ends off very rapidly like a hill slope, at the base of which, with beds drawn running against it, but not faulted, is massive sandstone and conglomerate, changing to sandstones and

shales with thin coal seams and limestone bed, up to Portnagee Colliery, north channel. The country is to a large extent covered by Boulder Clay.

VERTICAL SECTIONS.

651. Scotland, Sheet 2.

Illustrative of the Coal-fields of Fife.

Arranged by **J. S. Grant Wilson** on the scale of 40 ft. to an inch. Section I. is of the Fife Coal-field, from Inverleven to the base of the Dunfermline Coal-field. It shows a series of strata 5,799 ft. in thickness, with 585 separate beds distinguished. It commences at the top with Red Sandstones and Marls, which continue to 1,195 ft. There are three thin bands of limestones and two of coal, at about 420 ft. down, and many of the beds below this level are fireclay. The measures then become of the ordinary type, with the following seams:—Wall, 3 ft. 6 in. at 1,480 ft. to base; Barncraig, 6 ft. at 1,583; Upper Coxtool, 2 ft. 6 in. at 1,669 ft.; Under Coxtool, 3 ft. to 1,693 ft.; Den, 2 ft. at 1742 ft.; the Chemiss, 9 ft. at 1,819 ft.; Bush 3 ft. 9 in. at 1,883 ft.; the Parrot, 3 ft. 3 in. at 2,063 ft.; unnamed, 3 ft. at 2,099 ft.; Earl's Parrot, 2 ft. 4 in. at 2,163 ft.; the Bowhouse, 7 ft. at 2,230 ft.; Brankstone, 2 ft. 6 in. at 2,269 ft.; More, 1 ft. 9 in. at 2,337 ft.; Mangie, 2 ft. 4 in. at 2,406 ft.; Sandwell, 1 ft. 3 in. at 2.428 ft.; Dysart Main, in 6 bands, 19 ft. 2 in. at 2,658 ft.; and Seven Foot, in 5 bands, at 2,756 ft. Then follows a long series of measures, about 1,300 ft. in thickness, with no workable coals, and in the centre very thick sandstones. There are a few bands of fireclay, and the Levenshaw or Castle Cary Limestone at 3,638 ft., and the Gair or Calmy Limestone at 3,938 ft. Below 4,000 ft. we come to another series of coals, the Capledrae Parrot, 4 ft. 4 in. at 4,132 ft.; Lochore Parrot, 2 ft. 2 in. at 4.470 ft.; Bowersbank Splint, 3 ft. at 4,495; Index Limestone, 2 ft. 3 in. at 4,652 ft.; Comrie and Balbardie, 2 ft. 9 in. at 4,715; Blanhall, 4 ft. at 4,789 ft.; Smithy, 3 ft. at 4,802 ft.; Lochgelly Blackband Ironstone, 8 ft. 3 in. at 4,843 ft.; Little Splint, 4 ft. 3 in. at 4,962 ft.; Rough, 3 ft. 4 in. at 4,981; Main, 3 ft. at 4,995 ft.; Jersey, in 3 bands, 9 ft. 5 in. at 5,025 ft.; Swallow Drum, 4 ft. 9 in. at 5,043 ft.; Duddy Davie, 3 ft. at 5,096 ft.; Lochgelly Splint, 6 ft. at 5,142 ft.; Lochgelly Parrot, 3 ft. 6 in. at 5,156; Glassie, 2 ft. 9 in. at 5,241 ft.; Mynheer, 3 ft. 3 in. at 5,335 ft.; Five Feet Lackie, 4 ft. 8 in. at 5,404 ft.; Dunfermline Splint, 3 ft. 9 in. at 5,505 ft.; Stinking Foul, 1 ft. 3 in. at 5,574 ft. Below this comes the Hosie Limestone, 3 ft. at 5,705 ft., and 1 ft. at 5,799 ft.

Section II. is of the Kelty Coal-field, showing 742 ft. of strata, and containing the following coals:—Rough, 6 ft. at 105 ft.; Black Band Ironstone, 1 ft. at 220 ft.; Main, 4 ft. 3 in. at 240 ft.; Jersey, 7 ft. at 256 ft.; Kinglassie Splint, 3 ft. at 326 ft.; Bank, 3 ft. 9 in. at 413 ft.; Lochy, 5 ft. at 517 ft.; Mynheer, 5 ft. 2 in. at 576 ft.; Gin, 4 ft. 7 in. at 648 ft.; and Dunfermline Splint, 4 ft. 2 in. at 742 ft.

Section III. is of the Donibristle Coal-field, showing 523 ft. of strata, with the following coals:—Fourteen Feet, 5 ft. 6 in. at 117 ft.; Soft, 2 ft. 6 in. at 149 ft.; Duddy Davie (= Kinglassie), 3 ft. at 195 ft.; Lochgelly Splint, 7 ft. 3 in., and Parrot, 4 ft., the two at 284 ft.; Glasse, 5 ft. 2 in., and another, 2 ft. 4 in. at 387; Mynheer, 4 ft. at 427; Five Feet, 4 ft. 9 in. at 480; unnamed, 2 ft. 6 in. at 501 ft.; and Dunfermline Splint, 4 ft. 6 in. at 523 ft.

Of the coals here found, the underlying rock is Shale in 31 cases, Sandstone in 13 cases, and Fireclay [which is the only term which can mean underclay] in 14 cases. The shales are almost all in the Fife Coal-field.

FOREIGN GEOLOGY.

(Published in Britain.)

PHYSIOGRAPHY.

652. Howorth, H. H.—The Recent and Rapid Elevation of the Ural Mountains.

Geol. Mag., Dec. 3, vol. vii., p. 438.

He wishes to show that the elevation of the Urals is comparatively recent; a view which he says is "not entirely new." He proves it by quoting Murchison (Russia and the Ural Mountains, 1845), who shows that the Urals show no signs of glaciation. There is also the same fauna and flora on both sides, and the same deposit of black earth. Murchison also regarded the elevation of the Urals as the period of the destruction of the Mammoth. The author calls in a "great debacle," and supposes the elevation of the Urals caused the reversal of the Siberian rivers. [It must not be forgotten, however, that the Urals have their strata parallel to their direction, and as a range must have been produced by thrusts from east to west, and not by a vertical elevation.]

653. Howorth, H. H.—Did the Great Rivers of Siberia Flow Southwards, and not Northwards, in the Mammoth Age.

Geol. Mag., Dec. 3, vol. vii., p. 5. Read at Brit. Ass. in 1889.

He speaks of the land in the north of Siberia *now* rising, and then *states*, referring to a former paper (Geol. Mag., 1889), that the Arctic Sea was dry land during the "Mammoth Age" and has gone down since. He quotes figures from Ravenstein, giving the levels of the rivers at various towns: Tobolsk 266 ft., Omsk 279 ft., Tomsk 302 ft., Krasnoyarsk 499 ft., The rivers Ob and Yenisei have, therefore, only a fall of 250—300 ft., and there are sea beaches 500 ft. up. [This, no doubt, shows that if the northern elevation continued, it *might* reverse the rivers; but not that they have ever been reversed.] He then draws attention to the inland lakes, which were once continuous [as is well known. No proofs are submitted, though the suggestions may be true.]

654. Spencer, J. W.—The High Continental Elevation preceding the Pleistocene Period in America.

Geol. Mag., Dec. 3, vol. vii., p. 208.

The Mississippi Valley is filled with superficial deposits to a depth of 170 ft. at a distance of 1,000 miles from the mouth, and to a depth of 630 ft. and more at New Orleans. Thus the drainage area must have been formerly more than 630 ft. higher. But the teachings of the coast soundings are even more remarkable. Off the coast of the Mississippi delta there is a margin of a continental plateau submerged 3,600 ft., except where there is a still deeper channel of 900—1,200 ft. in the direction of the Mississippi. On the Pacific coast, there are three valleys now submerged to 2,400 and 3,120 ft., which break through the marginal plateau—itself submerged 600 ft. The soundings off the Delaware river show another valley, submerged 1,200 ft. If the Gulf of Maine were raised 600 ft., it would be a plain; but it would be traversed by rivers, one of which towards its mouth would be 2,064 ft. deep, indicating a minimum depression of 2,664 ft. In the St. Lawrence, the lower part of the Saguenay has a depth of 840 ft. This leads to a channel in the St. Lawrence 1,134 ft. deep. In the centre of the modern gulf, the old channel is submerged 1,878 ft., and the adjacent valley 1,230 ft. In the midst of the Newfoundland banks, in continuation of this river, there is a broad channel, bounded by the 605 ft. contour, which has a depth of 3,660 ft., and which leads into the ocean with an additional depth of 2,000 ft. The fact that Lake Ontario is 491 ft. deeper than sea level, and Huron 180 ft., &c., shows that the former elevation extended over the Continent. Thus, all round America there has been a depression of

3,000 ft. or more. These valleys may be very ancient, some dating back to Palæozoic times. It is remarkable, however, that the extreme height could only have been for a comparatively short period, as the greatest depths are near the submerged margin, and do not extend far back inland.

655. Spencer, J. W.—Origin of the Basins of the Great Lakes of America.

Q.J.G.S., vol. xlvi., p. 523. With sketch map.

The general argument of this paper is, that the Great Lakes are along the course and tributaries of a river whose lower part coincides with the St. Lawrence, and that the valleys were cut out by this river at a period of continental elevation, and these have been converted into Lake basins by differential movements of the land. The facts in support of this are as follows:—1. Ontario basin. Along the southern side the Hydrographic surveys have shown a submerged escarpment, followed to the north by a valley whose base is 738 ft. below the lake, from thence the ground gradually rises to the north. At the western end borings have shown an old filled-up channel of a depth of 292 ft., which is the continuation of the cañon of the Dundas valley. If this channel were empty, L. Erie would be drained by it. On the north side, 20 miles east of Toronto, is a submerged valley whose bed is 474 ft. below water, but whose boundaries are only 200 ft. below. 2. Lake Erie. This is generally only 84 ft. deep, but there are narrow bands (old rivers) with a depth of 210 ft. and 228 ft. The most easterly of these is south of the Dundas valley. 3. Lake Huron. The southern half is shallow, with submerged valleys. North of this there is a submerged escarpment trending south easterly, of a depth of 300 to 450 ft., and then running north to Georgian Bay. At one point the depth of the submerged valley is 750 ft. In the straits leading into Georgian Bay it is 306 ft., but may be partly filled with drift. Along the southern shores of Georgian Bay this valley is at a depth of 510 ft. below the water. 4. Lake Michigan is divided into two basins, the northern has a maximum depth of 864 ft., and there is a submerged vertical escarpment of 500 ft. The modern outlet is only 252 ft., but it may be drift filled. The southern has a depth of 576 ft., the surrounding plateau being submerged 300—342 ft. 5. Buried valleys revealed by borings. The channel from L. Erie to L. Ontario has already been made known. From Georgian Bay to Lake Simcoe the country is low and flat. Lake Simcoe is 140 ft. above Georgian Bay, but a well has here been sunk in drift to 280 ft. Continuing this line towards the depression in Lake Ontario, other borings along it have gone 50 ft. and 183 ft. below the level of Lake Huron, while on the east the limestones rise 150 ft. above it.

This proves a direct channel across from Lake Huron to Lake Ontario. Between Lake Huron and Lake Michigan there is a surface valley, with the Grand river running west to the latter, and a small river running east into Saguenaw Bay. Along the western part of this line there are depths of more than 200 ft. in drift, showing that the drainage has here been reversed. On the eastern part there is a drift well to 350 ft. below Lake Huron. He calls the river formerly running in this valley the "Huronian," the river once draining L. Erie being the "Erigan," and the main stream the "Laurentian." To complete the demonstration, he must explain the rocky barrier at the Thousand Isles. This he does by showing that it has been raised since the excavation of the valleys above proved. There are certain raised beaches, formed during a period of depression, which can be traced over the country, the most important of which is the "Iroquois." This beach, at the west of Ontario, is 363 ft. up; at 4 miles east of Watertown it is 730 ft. up; near Fine, on the borders of Adirondach, it is 972 ft. up. This shows a loss of fall in the valley of 609 ft. since the formation of the beach, which lies above the drift, the valley being below the drift. If this 609 ft. were restored, the valley would have ample outlet. These conclusions require that the land should have been higher. This has already been proved by marine soundings (*see* No. **654**). Glaciation has nothing to do with the question, the striæ having no relation to the trend of the recorded valleys.

656. Upham, W.—Quarternary Changes of Level.

Geol. Mag., Dec. 3, vol. vii., p. 492.

He refers to numerous estimates from various sources as to the length of post-Glacial time, which all combine to put it between 6,000 and 10,000 years, hence it could not be due to the maximum eccentricity as Croll supposed. It was caused by the great uplift proved by Prof. Spencer, of which he gives further details. The Hudson river ends in a deep submerged fiord with a maximum depth of 2,844 ft. Greenland is divided from North America by a great valley of erosion over 2,500 ft. deep in Davis' Straits, and diminishing to Smith's Strait. On the Pacific coast, Santa Barbara and Los Angelos, now separated by channels 600 to 1,000 ft. deep, were part of the land in early Quarternary times. Paget Sound, in North California, is an old land valley, which was once at least 900 ft. higher. There are no Pliocene deposits along the coasts. This great elevation caused the accumulation of ice, proved to reach from one to two miles thickness. While still laden the land sank, as shown by marine bands, descending some hundred feet lower than it is at present, and in post-Glacial times it has been rising unequally over the continent, the more northerly parts rising most.

657. Jukes-Browne, A. J.—The Date of the High Continental Elevation of America.

Geol. Mag., Dec. 3, vol. vii., p. 561.

He objects to Mr. Upham's idea of a depression of more than 3,000 ft. having taken place in post-Glacial times, that raised coral reefs are found up to 1,200 ft. in Cuba, and up to 1,800 ft. in Baraçoa; 1,300 ft. in Guadaloupe, and 1,100 ft. in Barbadoes, the lowest terraces being fresh and unconsolidated. Any depression was of earlier date than these, for underlying them in Jamaica is the white limestone, of deep-sea origin and Pliocene age, and in Barbadoes oceanic deposits only comparable to those between 6,000 and 12,000 ft., and also of late Pliocene age. He does not think the non-filling up of the submarine channels a proof of recent depression, as they may have been deeper, or may be kept open by return currents due to the surface river current.

658. Stirrup, M.—Hydrology of the Causses of Languedoc, the Gorges of the Tarn, its Caverns and Subterranean Streams.

Trans. Manch. Geol. Soc., vol. xx., p. 446.

These causses are calcareous Jurassic plateaux, worn into cañons; the top has an extreme, and the bottom a mild climate. The cañon cliffs are 650—2,000 ft. high. Montpellier-le-vieux is a collection of outstanding stones, left by weathering [like the Brimham rocks]. It is on the edge of the Causse Noir. The "avens" are large swallow holes leading down to caves. These caves are covered with stalagmites, and lead into long fissures.

[**659.**] **Hull, E.**—On the Physical Geology of Tennessee and adjoining Districts in the United States of America.

Paper read to the Geological Society on Dec. 10, but not published in 1890. Abstract sent to Fellows.

STRATIGRAPHICAL GEOLOGY—EUROPE.

660. Harris, G. F.—Notes on the Geology of the Gironde, with Especial Reference to the Miocene Beds.

Geol. Mag., vol. vii., p. 22.

This is a brief account of what is known, or may be seen under guidance, in the Bordelais. The author notes that what are now called Oligocene were formerly classed as Upper Eocene in England and Lower Miocene in France, so that we may expect to find some of our English Eocene fossils amongst those described as Miocene.

661. Richardson, R.—Observations on the Geology of a Part of the Puy de Dôme District of France.

Trans. Edinburgh Geol. Soc., vol. vi., p. 89.

A general account of a visit to the Puy de Pariou and the Puy de Dôme, not containing any original observations.

662. Könen, A. von.—On the Disturbed Rocks of North-Western Germany.

Abstract in Proc. Geol. Soc., p. 116.

He has observed that basalts are (in his country) generally erupted through synclinal fissures, and the intermediate anticlinals are worn away into valleys, as near Cassel. He thinks this is caused by the folding of the rock compressing the molten magma below the synclinal, and the breakage of the rock there affording an easy outlet. As the basalts thus extruded resemble not only in petrological composition but also in geological conditions modern lavas, the eruption of the latter may have a similar origin; which is quite independent of the explosive force which produces the outburst of gas and vapour.

663. Swan, R.—The Island of Paros, in the Cyclades, and its Marble Quarries.

Rep. Brit. Ass. for 1889, p. 570.

The northern and western parts consist of schist and gneiss, granite also appearing in the environs of Parekhia. The southern part of the island consists chiefly of crystalline limestone, which may be of Cretaceous age. The finest statuary marble, or "lychnitis," varies from 5 ft. to 15 ft. at the quarries of St. Minas. It occurs in a bed of coarse-grained white marble, with bluish black veins. The coarse marble becomes dark in colour near the lychnitis, both above and below, and thus the layer of statuary marble is distinctly marked off. The dark colour is due to traces of binoxide of manganese and magnetite. These impurities seem to have been withdrawn from the lychnitis, and become concentrated in the edges of the adjacent beds. There is also a good deal of excellent coloured marble in the island.

664. Lucas, R. N.—Notes on the Geology of Finland.

Geol. Mag., Dec. 3, vol. vii., p. 293.

This is a brief account of the Archæan rocks of the country, as seen with members of the Finnish Geological Survey, and extracted from the descriptions of the survey sheets. They are classed under two heads:—I. The Foliated rocks, including Granite-gneiss, Grey Gneiss, Hornblende Gneiss and Eurite, Mica, Hornblende and Actinolite Schists, named, as nearly as possible, in their order of succession. II. Non-Foliated rocks, including Quartzite and Fibrolite Quartzite, which, it is suggested, may be of eruptive origin, and Crystalline Limestones, which show contact alteration.

665. Murray, J.—The Maltese Islands, with Special Reference to their Geological Structure.

The Scottish Geographical Magazine, Sept., 1890, p. 449, with geological map and two plates.

The strata of Malta are more or less horizontal, and in the southern part of the island the highest land and highest strata are to the west. The continuity is disturbed by a nearly east and west main and other minor faults, letting down the higher beds. The other side of the trough is found N.W. in Gozo, beyond which the original position of the strata is continued.

The rocks distinguished are:—1. Upper Coralline Limestone, 300 ft. 2. Greensand, 0—35 ft. 3. Blue Clay, 1—40 ft. Globigerina Limestone, 250 ft. Lower Coralline Limestone, 500 ft.

The Upper Coralline Limestone is full of fragments of calcareous organisms, as shown in pl. i., fig. 1, but is occasionally crystalline. It contains 83—92 per cent. of carbonate of lime, and indicates a shallow water deposit. Thirty-seven kinds of Foraminifera are recorded, of which *Miliolina seminulum* and *M. trigonula* are most abundant.

The Greensand has many glauconitic grains and Foraminifera. It is often oxidized yellow. Remains of dugongs, manatees, dolphins, whales, and sharks occur. It is a deeper water deposit. It generally contains phosphoric acid. A list of 35 Foraminifera is given, the most abundant being *Miliolina seminulnm*, *Gaudryina*, sp., *Bolivina Karreriana*, *Truncatulina ungeriana*, *Operculina complanata*, and *Heterostegma depressa*, the latter forming a rock. Plate ii., fig. 2.

The Blue Clay or marl secures the water supply by aqueducts above it. The carbonate of lime varies from 2·56 to 30 per cent., and consists of Foraminifera, coccoliths, and coccospheres, the most abundant being *Globigerina*. A list of 120 species of Foraminifera is given.

The Globigerina limestone is mainly composed of globigerina shells and fragments. The upper part is bluer and more clayey, the bottom redder. The upper beds have numerous hæmatite nodules. The lower beds form third-rate building stones, but are very porous. They have also blue patches away from the neighbourhood of faults or fissures, and a comparison shows that this is the original colour, the rock being more oxidized elsewhere.

	Bluish.	*Reddish.*
Calcium Carbonate	78·39	80·24
Calcium Phosphate	2·70	3·57
Magnesium Carbonate	0·44	1·63
Calcium Sulphate	0·33	0·06
Iron and Alumina	—	1·13
Insoluble in $\frac{1}{10}$ H Cl	17·87	12·88
	99·73	99·51

The general appearance is given in plate ii, fig. 1, showing it to be quite composed of globular cells. Amongst

this series are 4 or 5 nodule beds at various horizons, two extending throughout the whole islands. They vary up to 3 or 4 ft., and consist of rounded concretions with a smooth brown glazed surface. They are mixed with corals, echinoderms, whales, turtles, sharks, &c. The nodules from Forim el Rieh Bay give on analysis—

	Nodule.	*Interstitial Matter.*
Calcium Sulphate	2·26	0·07
Calcium Carbonate	47·14	86·69
Calcium Phosphate	38·34	1·24
Alumina	5·98	1·28
Residue	6·08	9·87
	99·80	99·15

These limestones were formed in deep water (300—1,000 fathoms). 56 species of Foraminifera are recorded.

The Lower Coralline Limestones are largely crystalline, and the harder varieties form marbles. Some are composed of Nullipores, others of Nummuline Foraminifera, as on plate i., fig. 2. They are white to pink in colour and contain occasional phosphatic nodules. The deposit was probably made in water of 50 fathoms and more. Fourteen species of Foraminifera are given.

In these several limestones caves occur which have yielded—

Hippopotamus Pentlandi	Myoxus melitensis (Falc)
Elephas melitensis (Falc)	——— Cartei (Adams)
——— Falconeri (Busk)	Arvicola protensis (Baillon)
——— mnaidræ (Adams)	Cygnus Falconeri.

Off the shore Foraminifera are found forming limestones. Out of 103 species 16, 17, 37, 20, 2 are found in the several strata above described. A bibliography concludes the paper.

STRATIGRAPHICAL GEOLOGY.—AFRICA.

666. Thomson, Joseph.—Report of the Committee Appointed to Investigate the Geography and Geology of the Atlas Range in the Empire of Morocco.

Rep. Brit. Ass., 1889, p. 165.

The Atlas Mountains have been crossed in several lines west of Dernnat; they terminate 30 miles east of the coast. These mountains consist: 1. Of a central core of metamorphic slates and crystalline limestones, at places much disturbed by intrusive bosses, dykes, and veins of porphyrites, basalts, and diorites. 2. Of an enormous series of red and purple shales, marls, and sandstones, forming the great mass of the chain rising to a height of 11,000 ft. They appear to

be of Cretaceous age. 3. Of an upper series of cretaceous, cream and grey coloured limestones and sandstones, with *Trigonia*, *Arca*, *Gryphæa*, *Astarte*, *Lucina*, *Rhynchonella* cf. *tetrahedra* and *Astræa*. They have a small development, and only lie on the flanks. They have numerous intrusive bosses, and great dykes of amygdaloidal basalts. 4. Of later formations, of which little has been learned. There are some moraines at the head of certain glens, and boulders strew the Plain of Morocco; but on the whole the evidence of any glaciation is insignificant. He saw nothing of the enormous so-called glacial deposits described by Maw.

[**667.**] **Hull, E.**—Sketch of the Geological History of Egypt and the Nile Valley.

Paper read to the Victoria Institute on Dec. 1, but not published in 1890.

A "private and confidential proof" issued previously to the reading.

STRATIGRAPHICAL GEOLOGY.—AMERICA.

668. Gresley, W. S.—North American Geological Notes.

Trans. Manch. Geol. Soc., vol. xxi., p. 68.

Figures a specimen of banded black shale, which has been broken *in situ*, and surrounded with grey clay. In the roof of a coal seam at Illinois are some curious conical masses, standing point downwards, about 4 ft. wide and 4 ft. deep, ending always about 6 ft. or so above the coal, and filled with the same material as the outside. He thinks they are the "casts of the bottoms of hollow interiors of tree stumps;" they have a coaly coating. Seven fossil tree trunks, probably *in situ*, have been found in the roof of a 12 ft. seam of anthracite in Schuylkill Co., Pennsylvania. Boulders also have been found in these measures, (*a*) a well rounded boulder of grey quartzite, 11 in. by 8 in. by 6 in., buried in underclay at Mount Carmel Colliery; (*b*) a roughly wedge-shaped greenish purple slate, 12 in. by 5 in., in coarse grained sandstone, 200 ft. below the coals at Pottsville (*c*) a dark grey slate 9 or 10 in. long, in the roof of Pancoast Mine.

[**669.**] **Hodges, E. R.**—Notes on New England Geology, Botany, and Zoology.

Paper read to the Nottingham Naturalists' Society on Nov. 25, but not published in 1890.

670. Jeffs, O. W.—A Relic of an old Eruption.

"Research," vol. ii., p. 224.

He gives an analysis of "sand" which fell at Barbadoes

on May 2, 1812, presumably shot out of the volcano which erupted on April 27 of that year, at St. Vincent, from which Barbadoes is 80 miles to windward. It contains—

Silica	58·80
Alumina	20·44
Ferric Oxide	7·36
Lime	6·75
Magnesia	2·38
Alkalies, &c.	3·47
Water	0·80
	100·00

671. Karsten, H.—The Geological Age of the Mountains of Santa Marta.

Phil. Mag., ser. v., vol. xxix., p. 163.

There appears to be nothing new in this, which consists of discussions of statements made many years ago. There is a diagram section with sporadic observations of dip upon it. The age is pre-Cretaceous.

STRATIGRAPHICAL GEOLOGY.—AUSTRALASIA.

672. Haddon, A. C.—Notes on the Geology of Torres Straits.

Rep. Brit. Ass. for 1889, p. 587.

The western islands are composed of old igneous rocks, The centre are low coral *débris* islands; the eastern are volcanic; all are fringed with reefs, but there are no atolls, nor are there any signs of recent elevation or depression in Torres Straits.

GLACIAL AND SUPERFICIAL.

673. Geikie, J.—Address to Section C.

Rep. Brit. Ass. for 1889, p. 551.

This deals with glacial phenomena in general, the bulk of the illustrations being taken from continental districts.

The inner or central region of a glaciated tract leaves no doubt of the till being produced by land ice. The drifts of the peripheral areas do seem at first to have a different origin, for they contain deposits of stratified clay, sand, and gravel, and are not so compressed. It is not surprising, therefore, that they should be thought to be formed in water opposite the margin of a continental glacier. But "Giant's Kettles" are, more or less, commonly distributed under glacial deposits, and such "Kettles" could only have originated at the bottom of a glacier [are any such known

below actual glaciers?]. The pre-Glacial deposits, the brown coal and the chalk, have been horizontally smashed and mixed with the till. The boulder clay series thickens as we pass towards the periphery of the area, and the stratified deposits thicken likewise at a greater proportional rate, so that, almost absent in the centre, they alone are left at the periphery. He accepts the German explanation of this, viz., that the deposits were formed in sub-Glacial rivers and lakes, the "Kettles" produced by glacier mills, and the stratified masses by melted ground moraine. The ice sheet would be so far expanded that there would not be bulk enough or surface *débris* to form a terminal moraine; its limits are determined by the occasional presence of a scratch or an erratic.

The last extension of glacier ice in Europe was not so great. The end moraines circle round the southern coasts of Norway, by the lower end of Lake Wener to the head of the Gulf of Finland, and perhaps by the north of L. Onega to the White Sea; the Baltic was then a glacier. The upper boulder clay of these regions is the ground moraine of this latest ice sheet. In North Germany four glacial stages are recognised: 1. Marine deposits of a boreal or arctic character; 2. The "Lower Diluvium," which ploughed up the shell beds of the former; 3. Interglacial beds with a flora like that of North Germany to-day, and occupying a long period; 4. Another arctic period when the Scandinavian inland ice once more invaded Germany, ploughing through the interglacial deposits [but was not its end moraine at Lake Wener?].

Penk, Blaas, Böhm, and Brückner have demonstrated that ground moraines are composed mostly of materials detached from the underlying rocks by the glaciers themselves, particularly in regions so deeply buried under ice that superficial moraines were impossible. This action does not take place at the end of glaciers, but far up underneath, and the results can only be seen when the ice has melted.

He discusses the origin of loess as a possible interglacial deposit, and concludes it is for the most part of aqueous origin, chiefly from its uniformity of character, but some part has doubtless been worked up again by wind, but he sees no evidence in it of a dry-as-dust period in Pleistocene times. In this loess a "steppe" fauna has been discovered by Nehring, and the character of the mammals decides that it must have been Pleistocene, *i.e.*, interglacial, but the writer gives no opinion whether there have been more than one such period, it is a question of degree of intensity of cold. His long expressed views of the interglacial age of the implement-bearing gravels have been confirmed by the researches of Pruck, who shows

that they never occur within the areas occupied by the later glacial accumulations, and the same, according to Boule, is true of the cave deposits of France. "The Palæolithic age, so far as Europe is concerned, came to a close during this last cold phase of the Glacial epoch."

674. Jamieson, T. F.—On the Climate of the Loess Period, in Central Europe, and the Cause which Produced it.

Geol. Mag., Dec. 3, vol. vii., p. 70.

The Loess may be due to both river and wind, and Dr. Nehring having found in it the remains of animals now frequenting the steppes, concludes that Central Europe, at the time, must have had a very dry continental climate. This dryness, the author suggests, was not due to an extension of land to the west, but to an accumulation of ice to the north, extending west of Britain. This would shut out all sources of moisture except the remote Bay of Biscay. The loess is not, therefore post-Glacial, but as the northern glaciers increased, the southern ones may have gone back, and the fine detritus blown about might cover the beds of clay left by the ice. [It would be well if the author could point to any region where glaciers and dry sand drift are associated.]

675. Stiffe, A. W.—Note on the Glaciation of Parts of the Valleys of the Jhelum and Sind Rivers, in the Himalaya Mountains of Kashmir.

Q.J.G.S., vol. xlvi., p. 66.

This describes the glaciated appearance of the Sind at Sonamarg, viz., moraines, and a rounded outline of rock up to 2,000 ft. and more, above which the hills are rugged. The Jhelum Valley also has moraines as far as Mozufferabad, which contrast strongly with the "fans" produced by later rivers.

VERTEBRATE PALÆONTOLOGY.

[**676.**] **Crawford, J.**—Human Footprints in Recent Volcanic Mud in Nicaragua.

[**677.**] ————————On the Geology of Nicaragua.

Papers read to the British Association on Sept. 5, but not published in 1890.

678. Woodward, A. S.—Vertebrate Palæontology in some American and Canadian Museums.

Geol. Mag., Dec. 3, vol. vii., pp. 903, 455.

The author gives a brief account of the gems of the various collections at New York, Princetown, Philadelphia. He notes at Philadelphia that the specimen named *Mycterops* by Prof. Cope, and considered to be vertebrate, is not really Pteraspidian, but is an Eurypterid,—a caution of general value.

679. Lydekker, R.—On the Occurrence of the Striped Hyena in the Tertiary of the Val D'Arno.

Q.J.G.S., vol. xlvi., p. 62.

This is a defence of his having named a fragment of Hyena jaw from an unknown horizon in the Val D'Arno as *H. striata*, Dr. Werthofer (Deutsch. K. Ak. Wien., vol. iv., p. 341) having stated that all Hyenas found in that locality belong to the crocutine group. The specimen referred to is figured. It shows only the characters of the carnassial tooth, of which comparative dimensions are given with those of *H. striata* recent and from the Red Crag. [So far as can be judged from these, there appears much more difference between the recent *H. striata* and the Red Crag specimen than between the other two; but as no measurements of *H. crocuta* are given, the materials for a judgment are not provided.] He points out the differences between his specimen and all the Pliocene forms of the same locality [but does not compare it with any Pleistocene. It would be well that this matter were more definitely cleared up, because, if the determinations are correct,] *H. crocuta* has been replaced by *H. striata* in India, and *H. striata* by *H. crocuta* in Europe, a very remarkable interchange of habitat.

680. Lydekker, R.—Note on Certain Teeth referred to *Hyænodon indicus*.

Geol. Mag., Dec. 3, vol. vii., p. 402.

The author confesses that a friend has told him that two teeth from India and one from Quercy, which he referred to the lower jaw of *Hyænodon indicus*, are really the upper carnassials of *Amphicyon*. The Quercy specimens belong to *A. ambiguus* and the Indian to *A. palæindicus*. He notes that the figure he gave of *H. indicns* was of a left premolar, instead of the right.

681. Lydekker, R.—On a New Species of Otter from the Lower Pliocene of Eppelsheim.

Proc. Zool. Soc. for 1890, p. 3.

This species is distinguished from *Lutra dubia*, Blainville, to which the writer had referred it in Cat. Foss. Mamm., Brit. Mus., pt. i., No. 27,486, in having a very large inner cusp of the blade of the lower carnassial, whereas this cusp is very small in *L. dubia*. He compares it also with *L. Valetoni*, Fraas, and with others from India, and assumes it is distinct from recent forms, and therefore calls it *L. hessica*. It is an otter of the approximate size of *L. Ellioti*, with a somewhat larger inner cusp and cingulum to the lower carnassial, in which the inner wall of the talon is also rather higher. A figure is given.

682. Forsyth-Major, C. J.—Note on the Pliocene Mammalian Fauna at Olivola in the Upper Val di Magra (Prov. Messa-Carrara), Italy.

Geol. Mag., Dec. 3, vol. vii., p. 305.

In the autumn of 1889 the author made excavations in the Pliocene beds at Olivola, and has obtained a rich mammalian fauna, viz., *Felis arvernensis*, *Machairodus cultridens*, *Hyæna robusta*, *Canis etruscus*, *C. Falconeri*, *Ursus etruscus*, *Rhinoceros etruscus*, *Equus Stenonis*, *Mastodon arvernensis*, *Sus Strozzii*, *Cervus dicranius*, and *Leptobos elatus*, under which last name he gives reasons for including "all the known remains of bovine animals of the Italian and French Pliocene."

[**683.**] **Lydekker, R.**—On a Cervine Jaw from Algeria.

Paper read to the Zoological Society, Nov. 4, but not published in 1890.

[**684.**] **Marsh, O. C.**—On the Cretaceous Mammals of North America.

Paper read to the British Association on Sept. 5, but not published in 1890.

[**685.**] **Lydekker, R.**—On the Generic Identity of *Sceparnodon* and *Phascolonus*.

Paper read to the Royal Society on Dec. 18, but not published in 1890.

686. Lydekker, R.—On the Remains of some Large Extinct Birds from the Cavern Deposits of Malta.

Proc. Zool. Soc. for 1890, p. 403, pl. 35, 36.

The specimens collected by Admiral Spratt, and now in the British Museum, were all referred to *Cygnus Falconeri*, but most of them belong to a vulture and a crane.

The vulture he calls *Gyps melitensis*, and it is about one-fifth larger than *Vultur monachus*, and therefore the largest accipiter known except *Harpagornis*. The writer then traces in detail the similarity between the bones and those of the living *Vultur* and *Gyps*. There are the tibio-tarsus, the tarso-metatarsus, the femur, and a phalangeal bone, also some cervical vertebræ, which latter agree best with Gyps.

The crane he calls *Grus melitensis*. It is represented by very characteristic bones, viz., the proximal half of the right coracoid, the distal end of a left tibio-tarsus, and of a left tarso-metatarsus. These are figured side by side with the corresponding bones of living birds. The owner agreed typically in size with *G. antigone*, but differed in the smaller and narrower head of the coracoid, and the shorter bridge over the extensor groove of the tibio-tarsus.

The phalangeal bones of the *Cygnus Falconeri* are very short and stout in comparison.

687. Newton, E. T.—Note on the Bones of Small Birds obtained by Professor Natron from Below the Nitrate Beds of Peru.

Proc. Zool. Soc. for 1890, p. 375.

About 33 bones, with pieces of bill and vertebræ, have

been compared with those of a Petrel brought home by the "Challenger"—*Cyncochorea lenccorrhea*, Forbes—and agree closely; but as this species is not known to occur on the west coast of South America, but the allied form, *C. Markhami*, Salvin, does, the bones may belong to either of these, or to an allied form.

688. Newton, E.—On the Reported Discovery of Dodo's Bones in a Cavern in Mauritius.

Proc. Zool. Soc. for 1890.

The supposed Dodo's bones are frauds.

689. Seeley, H. G.—Researches on the Structure, Organisation, and Classification of the Fossil Reptilia. VI., On the Anomodont Reptilia and their Allies.

Phil. Trans., vol. clxxx. B, p. 215. Plates 9—25.

The author commences with an account of the foundation and expansion of the order, with critical remarks on specimens described, principally by Sir R. Owen. Not regarding the dentition of the Theriodonts as of ordinal value, the writer classes them with the other Anomodonts.

To discover the brain case, a longitudinal section of an unknown skull has been made. It shows extremely few bones—perhaps they were unossified—and two oval areas are marked out by sharp lines, connected by a band with the nasal aperture. These may in some way indicate the brain cavity.

He describes an occipital bone (B.M. $\frac{R}{1021}$) of an unknown animal. It is in the form of a segment of a circle containing $\frac{2}{3}$ the circumference. The basi-occipital diverges to about half the base, and has a saddle-shaped depression; the supra-occipital is the largest bone. Each exoccipital has two deep V-shaped grooves near the upper and lower margins. The condyle is trifid, the basi-occipital element being largest; the foramen magnum is tunnel-shaped. It rapidly expands by slanting borders into the brain case, seen on the other side, with remains of the sphenoid below. The triangular shape of the hind part of the brain case is shown in another specimen (B.M. 47,056). B.M. R. 868 is the back of the skull of *Dicynodon microtrema* (spec. nov.), which has a triangular foramen, hemispherical condyle, and the whole bone twice as broad as high; all the occipitals are anchylosed. Above them are a pair of inter-parietals, with other side bones "called into existence by the muscular attachment," and the broad sides are formed by the squamosal. The part of the brain case seen is very small and subhemispherical.

B.M. R. 866 represents a new genus and species, characterised by combined differences in the squamosal quadrate and pterygoid [which the imperfect figures do not aid

in appreciating]. The quadrate has a general resemblance to that of Ichthyosaurus.

A skull of *Dicynodon tigriceps* in the Bain collection shows clearly all the sutures of the anterior bones; the premaxillary is seen in cross section. The maxillæ are flattened and oblique; the large tooth is in the middle and not at the junction with the premaxilla, and is not therefore a "canine." The nasals are flat, and have swellings like two horns over the nares. The subnarial is entirely withdrawn from the external suture on the face as though it prefigured a turbinal. Prefrontals are only at the side, between the margin of the frontal and the nasals, where they form a protuberance. The frontals are flattened rhombs. He next gives [incomprehensible] figures of a separate quadrate bone with two distal condyles, and having a ridge of bone rising from the inner one, " which approximates to Ichthyosaurus, and would warrant its reference to a new genus."

B.M. 47,074 is a skull of *D. Copei* (spec. nov.), having the characters of the genus *Lystrosaurus* (Cope), viz., the face vertical to the superior surface of the head. The nares are circular and nearly confluent, the teeth are vertical. The palate shows the basisphenoid, with saddle-shaped bones behind and quadrate processes of the pterygoid fore and aft, a long pointed vomer, with a balloon-shaped depression at the base, and triangular palatines, enclosing with the latter the palatonares.

B.M. R. 872 is the skull of *Hyorhynchus platyceps* (gen. et sp. nov.). This has a slender, pig-like snout, relatively large orbits, and a narrow parietal region. The upper surface is convex, the orbits protrude above the level. The sutures are badly defined [and not shown at all in the figures]. The maxilla is imperfect, but has a straight inferior margin, but no certain indications of teeth. The general resemblance is to *Ælurosaurus*, but it is distinguished by the pig-like ridges on the snout.

The general character of Dicynodont skulls is summarised as follows:—There is "a solid jaw from which a vertical longitudinal median plate is prolonged backwards where it divaricates to contain the small brain. This wedge is terminated posteriorly by a more or less vertical occipital plate. Inferiorly, the back of the squamosal region is connected with the jaws by longitudinally-extended slender bars, which form the palate. Laterally, the squamosal extends towards the maxillary, forming a single lateral arch behind the orbit. Superiorly, the anterior part of the head is more or less flat, and horizontally extended parallel to the palate."

Cervical vertebræ are seen for the first time in association

with a skull of *Dicynodon tigriceps*. The first is an anchylosed atlas and axis. The next is a central piece without neural spine, the succeeding spine reaching forward over it. So large an "intercentrum" has not been hitherto known in true Reptiles. The cervical ribs have a forked articulation. The last centrum is conically excavated behind. Three dorsal vertebræ are figured; the surface of the centrum is conically excavated, it is constricted in the middle, has strong apophyses and high oblique compressed spines. He next figures nine caudal vertebræ already described by Sir R. Owen. The whole set is about 1 ft. long; the earlier ones have strong transverse processes, the later ones chevron bones, and the whole are massive to support the tail. This tail was originally supposed to belong to the sacrum, called *Platypodosaurus*; sections show an ossification of the intercentrum.

The scapular arch has a distinct precoracoid, but in some it is suturally connected, and some Reptiles have a perforation, as in this precoracoid, so in them the suture may be obliterated and thus a line of descent may be indicated. He figures a spathulate scapula (No. 36,272) and a pair of coracoids (36,286) with a broad inner convex side, and the swollen articulation forming the centre of the arc. A broad flat bone is next figured as the pubic bone of *Titanosuchus ferox* [without any reason being given for the name], it is suturally united to the ischium and perforated by the foramen. The centre is deeply depressed. He refigures the slab containing the forelimb, associated with the vertebral column and the commencement of the hind limb described by Owen as Dicynodont (Q.J.G.S., vol. xxxvi., pl. 17, p. 424). He regards it as not necessarily Dicynodont, but may have been Anomodont, and he calls it *Eurycarpus Oweni*. No. 49,368 is a restored femur of *Titanosuchus ferox*, Owen, in association with the skull so called. It is about 2 ft. long, straight and stout, flattened antero-posteriorly, expanded and oblique at the extremities, showing two large distal condyles. The humerus is next figured; it is a very massive bone, 1 ft. 9 in. long and more than half as broad, deeply and obliquely constricted to half the size in the centre, the two condyles are very swollen and the radial crest very large. The bone is not very twisted. The fibula is half as long, flattened and concave only on one side. The ulna is represented by 43,525, figured by Sir R. Owen as of *Pareiasaurus*, also by 36,249 and 49,389, which are isolated bones. These show an expanded proximal end, with a well marked ridged olecranon and rounded distal articulation. The bone is trigonal in shape, about 1 ft. long, and has epiphyses at each end, the proximal one with a convex and even junction, the distal with a deeply concave one. This is an unparalleled thing among Reptiles. With these are

two subcubical bones which may be phalanges. He next figures the tibia of an unknown genus. It is a short massive bone with a small lateral surface at the proximal end for the fibula, and has an internal distal talon as in mammals; the length is 1 ft.

The remains described by Owen as *Procolophon trigoniceps* have now been more carefully developed, and are described more in detail with some new features, only to be ascertained by close comparison. He figures the skull of *Galesaurus*, and makes general remarks. It differs from Dicynodonts in having incisor teeth, cuspidate molar teeth, a coronoid process in the lower jaw, like mammalia, and no descending tympanic process in the skull, nor basioccipital condyle, but the general resemblance to an opossum-like mammal's skull is remarkable. *Nythosaurus larvatus*, Owen, is a *Galesaurus*.

He then gives a general comparison between the South African Anomodonts and those from the Permian of Orenburg, and *Placodus*, which has a mammalian type of articulation of the skull with the vertebral column. He does not think the *Pelycosauria* of Cope can be separated from Anomodonts, as the chief characters relied on, viz., the union of scapula, coracoid, and epicoracoid into a single bone, like an os innominatum, and the possible presence of epiphyses can be matched in South African Anomodonts. The other features are not of ordinal importance. The *Proterosauria* are somewhat allied to Anomodonts in their pelvis, tarsus, scapular arch, and floor of skull. The *Saurischia* are allied in their pelvic bones and long bones. The skull of *Scelidosaurus*, of which he gives a restored figure of the floor, is formed on a different type, though showing some resemblance.

To explain theoretically the anomodont skull, he considers that when the additional bones are absent, they have not been lost by the growth of adjacent bones, but have failed to be originally differentiated. The quadrate of reptiles becoming the perforated tympanic of mammals is seen in process of development, and similarly with the malleus.

Finally he gives the following classification of the Anomodonts into sub-orders:—

Pareiasauria.—Basi-occipital articulation, no temporal vacuities, no median bar to interclavicle.

Procolophonia.—Median bar to interclavicle, no temporal vacuities, teeth on pterygoid and vomer.

Dicynodontia and *Gennetothera*.—Tripartite occipital condyle, descending process to squamosal, not more than one tooth in each maxillary.

Pelycosauria.—Ditto, but large laterally compressed incisors, separated by canines from small pointed molars.

Theriodontia.—No descending process to squamosal, which articulates with lower jaw; molar teeth with pointed cusps.

Cotylosauria.—Ex-occipital condyles, molar teeth transversely developed, with cusps.

Placodontia.—Ex-occipital condyles, crushing teeth on vomer, pterygoid, and maxillary.

690. Lydekker, R.—On Associated Remains of a Theriodont Reptile from the Karoo System of the Cape.

Proc. Zool. Soc. for Nov. 19, 1889, pl. liv., lv.

These bones are in a red matrix belonging to the Beaufort stage, in the Rouxville District, Orange Free State. The series consists of dorsal and caudal vertebræ, and parts of limbs and limb girdles. The centra of the dorsal vertebræ are long and somewhat compressed sideways, and the neural spines are flattened. The transverse processes pass outwards and backwards, and are supported by three buttresses. The centra are slightly cupped, have no intercentra, but show a notochordal canal. This, and the shape of the humerus, make the specimens Theriodont. The scapula is like that of *Platypodosaurus*. [He then makes a digression on certain scapulæ figured by Sir R. Owen.] The humerus shows an entepicondylar foramen and a large radial condyle, and "above this there is the supinator flange, on the preaxial border, which serves to distinguish the humerus of the Theriodonts from that of the Dicynodonts." This humerus resembles that of *Brithopus* from the Permian of Russia, and the possessor may have belonged to that genus.

[**691.**] **Lydekker, R.**—On a New Species of *Trionyx* from the Miocene of Malta, and a Chelonian Scapula from the London Clay.

Paper read to the Geological Society on Nov. 12, but not published in 1890. Abstract sent to Fellows.

692. Marsh, O. C.—The Skull of the Gigantic Ceratopsidæ

Geol. Mag., Dec. 3, vol. vii., pt. i., pl. i.

The Reptile skulls here described come from the Laramie Group of the Upper Cretaceous on the east side of the Rocky Mountains. They have been already described in the American Journal of Science, vols. 37, 38, and this paper has been read before the National Academy of Sciences, Philadelphia. The skull here figured in the largest of land animals, and it is only surpassed by some cetaceans, and when adult must have been 8 ft. long. It comes to a sharp cutting beak in front, has a strong horn on the nose, a pair of very large pointed horns on the top of the head, and a row of sharp projections round the margin of a transverse posterior crest. All these had a horny covering of great strength and power.

[**693.**] **Marsh, O. C.**—On the Gigantic Ceratopsidæ (or Horned Dinosaurs) of North America.

Paper read to the British Association on Sept. 4, but not published in 1890.

694. Lydekker, R.—On Two New Species of Labyrinthodonts.

Q.J.G.S., vol. xlvi., p. 289. Pl. xii., figs. 2, 3, 4.

The second of these is from the Karoo system of South Africa. It is represented by a mandible and an intercentrum. The mandible is 40 centimetres long; its outer surface is coarsely reticulate and ridged, and the broken teeth show labyrinthic structure. The dentary bone has 25 teeth, with an ovoid section perpendicular to the length ; outside, there is a longitudinal bony parapet, and along the inner margin a narrow band covered with shagreen-like denticles, stopping at the symphysial region. Each denticle has a pulp cavity. In this latter character, and in the general form of the bone, it agrees with *Eryops*, Cope. With this it also agrees in the absence of a post-articular process, which is present in *Rhytidosteus*, the only Labyrinthodont yet described from the Karoo, which, moreover, has no external parapet, and its band of denticles is outside the teeth. The intercentrum—probably of the same individual—is horse-shoe shaped (*i.e.*, is unossified axially), as is usual in the "rhachitomous" group, and it has an articular surface for the rib. In this, however, it differs from *E. megacephalus*, as also in the non-enlargement of the anterior teeth. These differences he does not regard as of generic importance, so calls these fossils *E. Oweni*, and remarks on the interest of this distribution of the genus. *Eryops* is said to be from Permian beds in Texas.

[**695.**] **Fritsch, A.**—Restorations of the Palæozoic Elasmobranch genera, *Pleuracanthus* and *Xenacanthus*.

Paper read to the British Association on Sept. 9, but not published in 1890.

696. Traquair, Dr. R. H.—Notes on the Devonian Fishes of Scaumenac Bay and Campbelltown, in Canada.

Geol. Mag., Dec. 3, vol. vii., p. 15. (Read at the Brit. Association.)

These notes are founded on a collection of the fishes from these localities, contained in the Edinburgh Museum, and are in correction of and addition to descriptions by J. F. Whiteaves (Trans. R. S. Canada, vol. iv., sec. 4, 1886 ; and vol. vi., sec. 4, 1888). The beds of Scaumenac Bay are Upper Devonian, and from these the author describes a new species of Cephalaspis (*C. laticeps*), a genus hitherto only known from the Lower Devonian. The fish called *Coccosteus acadicus*, from the Lower Devonian of Campbelltown, is referred to a new genus, *Phlyctænius*, which differs in the

forms of the bones of the cranial shield. He also describes as a new species *Cephalaspis Whiteavesi*, with a pointed front to the buckler; also a new species of *Gyracanthus* (*G. incurvus*), which is the first one of this genus recorded in any horizon lower than the Carboniferous.

697. Traquair, R. H.—On *Phlyctænius*, a new genus of *Coccosteidæ*.

Geol. Mag., Dec. 3, vol. vii., p. 55.

He here gives further details, with figures, of the cranial shield. (*See No.* **398.**)

698. Woodward, A. S.—On the Occurrence of the Devonian *Onychodus* in Spitzbergen.

Rep. Brit. Ass. for 1889, p. 584.

Printed *in extenso* in the Geol. Mag., Nov., 1889. A small arched bone from Mimes Dal, in the Stockholm Museum, agrees with the "presymphysial" bone of *Onychodus*. The four teeth are of smaller size, and with larger internal cavity than in *O. anglicus*. He calls it *O. arcticus*.

699. Davis, J. W.—On a New Species of *Coccodus* (*C. Lindstromi*, Davis).

Q.J.G.S., vol. xlvi., p. 565, plate xxii.

This fish is in the Museum of the Academy of Stockholm, and is from the Hard Chalk of Hakel in Mount Lebanon. It shows for the first time the outline of a fish of this genus. It is nearly related to *C. armatus*, Pictet, but differs in the posterior basal extension of the dorsal spine, and in the closer approximation of the dorsal fin to the head. The head is large and pointed with overhanging premaxillaries. The bones are covered by small tubercles. The front of the body, as far as the dorsal spine, is covered by tuberculated osseous plates. The rest is now naked. The dorsal spine is large, in the centre of the back, striated, with nine or ten denticles behind. The centra of the vertebræ are unossified. The neural arches have neurapophyses. The dorsal fin is about one-tenth the length of the body, and a little in front of mid-way between the spine and tail. It is supported by nine interneural spines. The caudal fin is rounded, and has articulated rays. The anal fin is short and below the dorsal. No paired fins are seen, and the dentition is not clear. Some bones of the head are also described.

[**700.**] **Woodward, A. S.**—On the Discovery of a Jurassic Fish Fauna in the Hawkesbury Wianamatta Beds of New South Wales.

Paper read to the British Association on Sept. 9, but not published in 1890.

701. Davis, J. W.—On the Fossil Fish of the Cretaceous Formations of Scandinavia.

Scientific Transactions Royal Dublin Soc., vol. iv. (series ii.), p. 363, with plates xxxviii. to xlvi.

[This memoir shows the cosmopolitan character of Geology, as the fossils of Sweden and Denmark are described by an Englishman in an Irish Society's transactions.] The fossils are contained chiefly in the museums of Lund, Stockholm, and Copenhagen, and are from the uppermost soft chalk of Faxoe and Scania. The general facies more closely resembles that of the English chalk than that of the cretaceous beds of the Lebanon, and three specimens are said to belong to Tertiary forms. The greater number consist of the common shark's teeth, and, since many belong to the family of the *Lamnidæ*, he discusses the genera of this family. The principal object appears to be to show cause for not accepting A. S. Woodward's proposed alteration of the genera, in his catalogue of Fossil Fishes, whereby "the great bulk of the teeth of *Lamna*, previously described, are referred to the genus *Odontaspis*, and those of *Otodus* to the genus *Lamna; Otodus*, except as a synonym, dropping out of the vocabulary," and "the Lebanon genus *Rhinognathus*, re-named *Scapanorhynchus*, is accepted." He says that "one of the principal difficulties seems to be that it should be desired to make an extremely large series of fossils, representing an enormous development of the Selachians, fit to a minimised series of living representatives which are rapidly dying out," and he consequently retains the earlier classification as at least a guide to form. The following are the species described :—

Sub-class Elasmobranchii, order Selachii, sub-order Tectospondyli, family Myliobatidæ: *Myliobates*, sp.; *Ptychodus decurrens*, Ag.; *P. mammillaris*. The Ptychodonts have been shown to be true Rays, and not allied to the Cestracionts.

Sub-order Asterospondyli, family Notidanidæ: *Notidanus microdon*, Ag.; *N. dentatus*, A. S. W. Family Scyllidæ: *Scyllium planum*, spec. nov., pl. xxxviii., fig. 9. A small tooth with one fang and three cones, the centre one half as high as the tooth is broad. Family Lamnidæ: *Scapanorhynchus tenuis*, spec. nov., pl. xxxviii., figs. 10—13. Crown more gracefully and slenderly attenuated, base smaller and denticles more minute than *S. latus*, spec. nov., pl. xxxviii., figs. 14—17. *S. gracilis*, spec. nov., pl. xxxviii., figs. 18—20, near *S. subulatus*, Ag., but with erect denticles, smaller and with more concave sides than the other two. [No reason is given for separating these generically from *Odontaspis*, from which they are said to be "not readily distinguishable"]. *Odontaspis acuta*, Davis, with two lateral denticles on each side. [This species has been described from the Oligocene of New Zealand.] *O. acutissima*, Ag., a single small tooth with sharp and conspicuous lateral den-

ticles. *O. faxensis*, spec. nov., pl. xxxviii., fig. 26, with three denticles on each side. *O. Kopingensis*, spec. nov., pl. xxxviii., figs. 27, 28, has only one pair of denticles, which are blunter and more erect than in *O. acuta*. *Oxyrhina Mantelli*, Ag.; *O. Lundgreni*, spec. nov., pl. xxxix., figs. 8—13. Crown long and erect, lateral extensions of the root widely separated, making the under surface peculiarly flat. It may belong to a new genus. *O. zippei*, Ag.; *O. conica*, spec. nov., pl. xl., figs. 8—10. Teeth small, long, tapering to a sharp point somewhat sigmoidal [no comparison with allied species is made except that they are like the teeth called *Odontaspis constrictus*, Egerton]. *Lamna elegans*, Ag.; *L. incurva*, Davis; *Otodus appendiculatus*, Ag.; *O. limhamnensis*, spec. nov., pl. xli., fig. 12. Both root and crown are thicker than in the last, and the crown is more convex both outside and inside. *O. obliquus*, Ag. A single large but well-marked tooth. "There appears no alternative but to place it with this [Tertiary] species." *Carcharodon Rondeletii*, Müller and Henle. The specimen is half a tooth only; it "agrees in all essential particulars with the specimens described by L. Agassiz as *C. sulcidens* from the Tertiary strata of Italy," and this R. Lawley has shown to be the same as the recent tropical species. [Considering the slight changes in the forms of teeth, even in distinct genera, this can scarcely be taken as evidence that a cretaceous species of so high an organism is still living.] *Corax Lindstromi*, spec. nov., pl. xlii., figs. 3—11: Intermediate between *C. pristodontus* and *C. falcatus*, but opinions differ as to whether there are one or many cretaceous species of this genus.

Order HOLOCEPHALI, family EDAPHODONTIDÆ: *Ischyodus brevirostris*, Newton.

Order GANOIDEI, family PYCNODONTIDÆ: *Cœlodus subclavatus*, Ag.

Sub-class TELEOSTEI, Order ACANTHOPHERYGII, family BERYCIDÆ: *Hoplopteryx lundensis*, spec. nov., pl. xliii., figs. 1—3. Fish bodies and skulls. The scales are smaller than in other described species, the dorsal fin has 10 spinous rays, followed immediately by 8 or 10 articulated ones. The vertebræ are 30 in number. It is a long, oval fish, with serrated operculum, and well marked curved lateral line. *H.*, sp., with scales like those of *H. lewesiensis*. *H. minor*, spec. nov., pl. xlv., figs. 3, 4. This is smaller and imperfect, no scales being preserved. [No reasons are assigned why this is called *Hoplopteryx*, the preoperculum is drawn crenated and not serrated, the direction of the mouth is different, and it does not appear evident from the figures that 3 and 4 are the same species of fish.] *Berycopsis Lindstromi*, spec. nov., pl. xliv., fig. 1. A flattened mass imperfect in outline. It has close set scales, which are said to

be wanting in "pectinations on the free margin" [but the figure shows a pectinated scale], but has "a minute imbrication." Family TRICHIURIDÆ: *Euchodus*, sp., *Bathysoma Lutkeni*, gen. et spec. nov. *Bathysoma* is defined as "Body compressed and elevated, head large, snout prominent, scapular arch composed of bones of great length and thickness." "Scapula," "coracoid," and "clavicle" are drawn as forming a scimitar-shaped mass joining the "interoperculum" to the pubic bone. The fish is small, the head ⅜ the length, the outline rhomboid, tail small, operculum of four elements, vertebræ 30, of which 10 are abdominal, hæmal spines longest, interspinous bones more numerous. It is compared to *Lampris luna*, *Capros aper* and *Gastronemus rhombeus*.

Order PHYSOSTOMI, family CLUPEIDA: *Clupea Lundgreni*, spec. nov., pl. xlv., fig. 5. The specimen so named consists only of a number of closely set vertebræ, with thin spines and remains of a dorsal caudal and [perhaps] an anal fin [no reasons are given for assigning this fish to *Clupea*, and none of the characters of the genus, as stated, are described as shown in the fossil]. Family HOPLOPLEURIDÆ: *Dercetis limhamnensis*, spec. nov., figs 1, 2. The head and vertebræ are preserved, with small bones, which are called scutes. The genus has on the sides three rows of these, which are said to be "heart-shaped, osseous, with a granular external surface, and surmounted by an angular median projection. The scutes in the specimen, 4 or 5 being shown, have "on each side aliform expansions of the surface, and the posterior margin is made up with a pair of projections" [in other words the form is entirely different]. The vertebræ (18) are shorter, the upper jaw of the genus is said to be longer than the lower [in the figures the reverse is the case].

INVERTEBRATE PALÆONTOLOGY.

702. Gregory, J. W.—Invertebrate Palæontology in some Continental Museums.

Geol. Mag., Dec. 3, vol. vii., p. 441.

The author gives an account of the contents of the Museums at Hamburg, Berlin, Dresden, Prague, Vienna, Munich, Stuttgart, Tübingen, Heidelberg, and Bonn.

703. Foord, A. H.—Description of Fossils from the Kimberley District, Western Australia.

Geol. Mag., Dec. 3, vol. vii., p. 98, 145. Plates iv.—vii.

These descriptions comprise the following:—*Salterella Hardmanni* (sp. n.). *Olenellus? Forresti* (sp. n.), from the Cambrian. *Atrypa reticularis*, *Rhynchonella pugnus*, *Rh. cuboides*, *Orthoceras*, *Goniatites*, from the Devonian. *Strophalosia Clarkei*,

Aviculopecten tenuicollis, *Goniatites micromphalus*. *Spirifera Kimberleyensis* (sp. nov.), *Sp. lata; Sp. Hardmanni* (sp. n.); *Sp. Musakheylensis*, var. *australis; Syringothyris exsuperans; Athyris Macleayana; Productus tenuistriatus*, *P. subquadratus*, *P. undatus*, *Reticularia lineata*, *R. crenistria*, *Orthotetes crenistria; Pachydomus carinatus; Bellerophon decussatus*. It is interesting to note that so many can be identified with well known Carboniferous Brachiopods.

704. Nicholson, H. A., and Hinde, G. J.—Notes on the Palæontology of Western Australia.

Geol. Mag., Dec. 3, vol. vii., p. 193.

These comprise *Actinostroma clathratum*, *Stromatoporella Eifeliensis*, from the Devonian, *Amplexus pustulosus*, *Cyathophyllum virgatum* (sp. nov.), *C. depressum* (sp. nov.), *Plerophyllum australe* (sp. n.), *Pachypora tumida* (sp. n.), *Syringopora reticulata*, *Aulopora repens*, *Spirorbis omphalodes*, *Polypora australis* (sp. n.), *Hexagonella dendroidea*, *Rhombopora tenuis* (sp. n.), all from the Carboniferous or doubtful Devonian.

705. Hudleston, W. H.—Further Notes on some Mollusca from South Australia.

Geol. Mag., Dec. 3, vol. vii., p. 241, pl. ix.

These are descriptions of specimens brought by H. G. Lyell Brown to the Colonial Exhibition. They comprise *Ammonites* (Lioceras) *fontinalis* (sp. nov.), *Alaria*, sp.; *Turbo*, sp.; *Actæon*, sp.; *Pecten*, sp.; *Pseudavicula anomala*, *Pinna australis* (sp. nov.), *Mytilus*, sp.; *Mytilus linguloides*, *Modiola subsolenoides* (sp. nov.), *Thracia primula* (sp. nov.) The whole group has a very Upper Jurassic aspect about it.

706. Jones, T. R.—On some Small Bivalve Shells from the Karoo Formation, South Africa.

Geol. Mag., Dec. 3, vol. vii., p. 409.

These are little shells on the surface of a block from Kat River, Eastern Province, South Africa, in the museum of the Geological Society. He names them *Cyrena neglecta*.

707. Jones, T. R.—On some Fossils from Central Africa.

Geol. Mag., Dec. 3, vol. vii., p. 533.

These are some bivalves brought by Prof. Drummond from Maramina, N.W. of Lake Nyassa. He refers them to *Iridina* ? from the Karoo formation, and names them *I. oblonga* (sp. nov.). The notice is preceded by a discussion of the nature of the coal found on the west shore of Lake Nyassa.

708. Waters, A. W.—North Italian Bryozoa.

Abstract in Proc. Geol. Soc., p. 123.

The species are described (in the paper) in relation to their ovicells. They are from Lower Tertiary beds. It is noted that the genus *Catenicella* occurs, and that *Porina coronata* and *Lepralia syringopora* both have closures formed

by a plate with a tubule in the centre, a character supposed to be confined to the Cyclostomata.

709. Stirrup, Mark.—Notes on the Carboniferous Insects found at the Commentry Mines (Allier), France.

Trans. Manchester Geol. Soc., vol. xxi., p. 93.

The strata here lie on gneiss, and there are no other sedimentary Palæozoic rocks. The coal is drift coal. The depressions in which it lies are narrow and deep cracks, produced by pre-carboniferous rupture. The insect remains obtained in ten years number 1,500, and the writer, having inspected most of the types, confirms the fidelity of the drawings. The Orthoptera, Neuroptera, and Hemiptera are clearly represented, but the Coleoptera are doubtful. In some there are wing-like structures attached to the prothorax, which are, in reality, stumps of wings, comparable to the Elytra of the Phasmidæ. Similar expansions are met with in *Lithomantis carbonaria* from Scotland. Some of the female *Blattæ* were provided with borers.

710. Etheridge, R., Jr.—On the Occurrence of the Genus *Turrilepas*, H. Woodw., and Annelid Jaws in the Upper Silurian (? Wenlock) Rocks of New South Wales.

Geol. Mag., Dec. 3, vol. vii., p. 337, pl. xi.

The plates referred to *Turrilepas* occur associated in an approximation to their natural position in the Lower Trilobite bed of Bowning, and are called *T. Mitchelli.* From the same bed come the little jaws to which are assigned the names *Eunicites Mitchelli*, *Arabellites bowningensis*, and *Ænonites labes.*

711. Jones, T. R.—On some Devonian and Silurian Ostracoda from North America, France, and the Bosphorus.

Q.J.G.S., vol. xlvi., p. 534, plates xx., xxi.

The following species are described:—1. *Primitia Clarkei* (sp. nov.), less oblong, diagonally oblique, more convex than *P. humilis*, with its normal pit large and furrowless. Ontario Co., New York. 2. *Beyrichia devonica*, Jones. Bosphorus. 3. *B. subquadrata* (sp. nov.), squarer, and length $\frac{4}{3}$ height, instead of twice as in *B. devonica.* 4. *B. Klædeni*, M'Coy, var. 5. *B. Kolmodini* (sp. nov.). The front is narrower, the back rounder, and with the separate portion of the anterior lobe larger than in *B. clavata*, Kolmodin. 6. *Eurychilina reticulata*, Ulrich. 7. *Bollia bilobata* (sp. nov.), like *B. bicollina*, but larger. There are two separate unequal lobes on the surface. Nos. 3—7 are from Ontario Co., New York. 8. *B. Hindei* differs from *B. bicollina* in being longer, having a thicker marginal ring and a short curve to its horse-shoe ring, the hinder part having an oblique furrow. 9. *Strepula plantaris* (sp. nov.). In outline like the sole of the foot, with tortuous ridges. Front end 6-spined. Nos. 8 and 9 are from Eighteen Mile Creek, L.

Erie. 10. *Octonaria Linarssoni* (sp. nov.) ornament a spiral ridge, which is thick at the posterior edge, becoming gradually thin to the completion of the spiral turn, leading to a confused mass in the centre. From Clarke Co., Indiana. 11. *Moorea Kirkbyi* (sp. nov.), simple, with ridges only at the ends of the valve. From Ontario Co., New York. 12. *Primitia Walcottii* (sp. nov.), with a central pit and covered with narrow curved ridges and furrows, irregular, but longitudinal towards the centre. 13. *Ulrichia* (gen. nov.) has two medio-dorsal knobs in place of a furrow [but compare the figures of *Beyrichia* and *Bollia*]. *U. Conradi* (sp. nov.) has the front tubercle the smaller, the surface is finely reticulate and there is a neat marginal ridge on the free borders. Nos. 12 and 13 from Thetford, Canada. All the above are Devonian.

14. *Beyrichia difissa* (sp. nov.), narrow lobed, front lobe long, triangular, split lengthwise; the middle and hinder lobes unite below. 15. *Leperditia frontalis* (sp. nov.), with antero-dorsal angle strongly pronounced, rhomboidal, oblique, smooth. 16. *Primitia Billingsii* (sp. nov.), oval, smooth, with large shallow umbilical pit, and fringed all round by a radial lip. 17. *Bollia semilunata* (sp. nov.), small, with a thick and high horse-shoe lobe reaching half across the valve, outline two-thirds of a circle, with strong marginal ridge. 18. *Bythocypris? Lindstrœmi* (sp. nov.), like *B. symmetrica*, but larger and more tapering at the anterior third. 19. *Bairdia anticostiensis* (sp. nov.), elongate, very convex, smooth, but dorsal border becomes concave posteriorly, forming a sharp triangular process. 20. *Macrocypris subcylindrica* (sp. nov.), long, trapezoidal, ends oblique in the same direction, smooth, convex. 21. *Bythocypris obtusa* (sp. nov.), near *B. symmetrica*, but, being blunter in front, has almost equal ends. 22. *Polycope sublenticularis* (sp. nov.), round, but dorsal border sub-angular, hinge line unknown. All the above (14—22) are from Anticosti.

Lists, with notes, are then given of ostracoda from Dundas, Ontario, Canada, in the collection of the Geological Survey of Canada, from several Formations. New species are noted, but not named.

Finally, a description is given of *Beyrichia Guillieri*, Tromalin, from the Lower Silurian of Brittany, and is figured for the first time. It is three-lobed; the two smaller lobes in front are club-shaped; the larger posterior lobe is leg-of-mutton shaped; they join a ventral longitudinal swelling.

712. Jones, T. R.—On some Palæozoic Ostracoda from N. America, Wales, and Ireland.

Q.J.G.S., vol. xlvi., p. 1, pl. i.—iv.

This is simply a mass of descriptions. The new species from N. America are as follows:—*Primitia Whitfieldi*,

Cincinnati; *P. Ulrichi*, Utica; *Entomis rhomboidea*, and *Strepula sigmoidalis*, Hamilton; *Beyrichia Hallii*, Waterline; *B. Clarkei*, Helderberg; *B. Hamiltonensis*, *Isochilina lineata*, and *I. fabacea*, Hamilton; *Leperditia Claypolei*, Cincinnati; there are also notes on *Primitia unicornis*, *P. minuta*, *Primitiopsis punctulifera*, *Æchmina spinosa*, *Æ. Byrnesi*, *Bollia symmetrica* (not figured), *B. lata*, *Klædenia notata*, *Beyrichia trisulcata*, *B. granulata*, *B. oculina*, *B. Buchiana*, *B. parasitica*, *B. æquilatera*, *B. tuberculata*, *B. ciliata*, *B. oculifera*, *Isochilina Seeleyi*, *I. gregaria*, *I. cristata*, *Leperditia seneca*, *L. sinuata*, *L. Hudsonica*, *L. alta*. All but one of these are figured.

713. Jones, T. R.—On some Fossil *Estheriæ*.

Geol. Mag., Dec. 3, vol. vii., p. 385, pl. xii.

The author describes *Estheria Lewisii* (sp. nov.) from the Trias of Bucks Co., Pennsylvania, and gives figures and discussions on various other Triassic Estheriæ from various other North American and German localities, viz., *E. minuta* and *E. laxitexta*.

714. Gregory, J. W.—Some Additions to the Australian Tertiary Echinoidea.

Geol. Mag., Dec. 3, vol. vii., p. 481; pl. xiii., xiv.

These are from Tertiary beds at Willunga, near Adelaide, and from the cliffs of Murray R. at Morgan. The species described and figured are *Cassidulus longianus* (sp. nov.), *Echinolampas ovulum*, Laube; *E. posterocrassus* (sp. nov.), *Cardiaster tertiarius* (sp. nov.), *Pericosmus M'Coyi* (sp. nov.), *Pericosmus compressus*, Duncan; *Cœlopleurus pancituberculatus* (sp. nov.), *Hemiaster planedeclivis* (sp. nov.).

715. Dawson, Sir J. W.—On Burrows and Tracks of Invertebrate Animals in Palæozoic Rocks, and other Markings.

Q.J.G.S., vol. xlvi., p. 595.

The author details various observations which throw light on the character and origin of certain marks which have been variously interpreted.

1. *Bilobites*, *Rusichnites*, *Protichnites*, and *Climatichnites* are all considered to be tracks of crustaceans allied to *Limulus*, similar markings being made by modern *Limuli*. *R. Grenvillensis* ends in a burrow. *R. acadicus* is made by successive strokes of a crustacean tail with marks of the carapace and limbs. *R. Clintonensis* (sp. nov.) may be a trail or casting of a worm. *Protichnites* with spots and *Climatichnites* with transverse ridges are associated in the same slab, and may be made by the same animal under different circumstances, as is the case with the *Limulus* tracks. *Phytoderma* is a burrow. 2. A vertical section of a *Scolithus* shows that it is the termination upwards of a burrow, *i.e.*, it is a casting; some are radiating and bifurcated, and *Astropolithon Hindei* has the aspect of a coral. 3. *Sabellarites* (gen. nov.). Transverse and longitudinal

sections show a tube composed of fragments, as in the Sabella. Those in which the fragments are arenaceous he calls *S. trentonensis*. Those with thick walled phosphatic tubes *S. phosphaticus*. Both from the Silurian. 4. Trunk-like concretions in the Potsdam Sandstone. These resemble on a large scale the clay concretions formed round vegetable fibres in the alluvial clay of the St. Lawrence, and have probably a similar origin. 5. Combinations of worm tracks, with ripple marks and shrinkage cracks. The tracks are in the furrows, or have been worn flat on one side. 6. Branching tracks. These are cylindrical, and diverge from a common centre, and are thereby distinguished from the alternate ramification of fucoids. 7. Rill marks, as distinguished from animal or plant impressions. Some from the Carboniferous of Nova Scotia resemble branching plants, but are caused by little rills on slimy surfaces uniting to form larger ones. The so-called genera, *Dictuolites*, *Dendrophycus*, *Delesserites*, *Vexillum*, *Aristophycus*, *Chloephycus*, and *Tricophycus* are of this character. All the specimens here referred to are figured (19 figures), some of them from photographs.

MINERALOGY.

716. Ulrich, G. H. F.—On the Discovery, Mode of Occurrence, and Distribution of the Nickel-Iron Alloy, Awaruite, on the West Coast of the South Island of New Zealand.

Q.J.G.S., vol. xlvi., p. 619, pl. xxiv.

This paper gives futher details of the localities and mode of occurrence of the mineral, discovered by analysis by Wm. Skey; the information being derived from accounts and specimens brought home to Wellington by prospectors. A map is given of the district between Jackson's River and Hollyford Valley. The mineral is found in specks enclosed in holo-crystalline peridotite intrusive in crystalline schists. This rock weathers red, hence the name of Red Hill, but it extends much further north, in the Olivine and Hope ranges, on either side of the Cascade River. The principal constituents are olivine and enstatite; the latter, on weathering, stands out on the surface. The rock changes irregularly to serpentine, and associated with both are gabbro dykes. Another variety contains more enstatite, and possibly also diallage. Its analysis gives:—

S_1O_2	39·99
Al_2O_3	3·55
Fe O	8·56
Cu O	4·19
Mg O	41·26
H_2O	2·07
	99·62

And the average specific gravity is 3·17—3·35.

The Awaruite has been found in 15 different places, scattered over the area of these rocks, as well as in the river gravel. The plate gives nine microscopic sections of the peridotite.

717. Moody, T. P.—On the Occurrence of Amberite in Coal at Kawa Kawa Colliery, Bay of Islands, New Zealand.

Proc. Geol Assoc., vol. xi., p. 440.

He gives an analysis of the mineral as, Carbon 76·88, Hydrogen 10·54, Oxygen 12·76. [But as these add to 100·18, and oxygen is generally given by difference, this is rather hard to understand.] The section is as follows :—

	ft.	in.
Soft Clay, with gravel and boulder sandstone	81	0
Hard calcareous bluish sandstone, with shales (marly greensands)	97	10
Coal Formation, Fireclay, Sandstones, and Coals ..	30	11
Dioritic Slate.		

He thinks it is a gum derived from [an extinct species of ?] Kauri, the beds being of Cretaceo-Tertiary age.

PETROLOGY.

718. Bonney, T. G.—Preliminary Note on the Alleged Occurrence of Fossils in the Crystalline Schists of the Lepontine Alps.

Rep. Brit. Ass. for 1889, p. 571.

This is more fully developed in the Quarterly Journal of the Geological Society.

719. Bonney, T. G.—On the Crystalline Schists and Their Relation to the Mesozoic Rocks in the Lepontine Alps.

Q.J.G.S., vol. xlvi., p. 187.

This is a paper of general interest, because it is a contribution towards the proof of the following wide-reaching propositions.

I. "That a group of truly crystalline schists is always [note this] more ancient than any rock to which, on the evidence of fossils, a date can be assigned."

II. "That many such groups can be proved to be older than any Palæozoic Rocks."

III. "The evidence" "in support of the claim" of "crystalline schists" to be "metamorphosed sedimentary strata of Palæozoic, &c., age," "has hitherto always broken down."

IV. That "crystalline schists," "in certain cases," show "structures" "indicative of sedimentation," and "a sequence" "due to successive deposition."

These conclusions have been recently assailed by the assertion "that in certain districts of the Alps there is a passage from Jurassic rocks into truly crystalline limestones, while in others, fossils of that age occur, together with garnet, mica, and a mineral resembling staurolite, in "schists that cannot be distinguished from" true crystalline schists. The author has examined these districts. I. *The Andermatt Section.*—Here there is a strip of rocks between some "Urseren gneiss" on the one side, and "sericite gneiss" on the other; beyond which latter are some phyllites and black slates, called Carboniferous. Next the Urseren gneiss is: 1. Black, slaty, or schistose rock. 2. Calc-mica schist. 3. Marble, quarried at Altkirk. 4. Calc-mica schist, and then the sericite gneiss. [These four are the supposed Jurassic rocks passing into crystalline schists.] The marble is said to contain fossils at one spot, but he could fine none. He found, however, some tube-like markings filled with finer crystals, often dying away into granules, which, though looking rather organic, he explains by distortion and crushing. The marble and the calc-mica schists are true crystalline schists. The black slates are not, he thinks, squeezed mica schists, but true phyllites, *i.e.*, partially metamorphosed slates, in which some large silicate crystals are porphyritically developed. The same succession was found in the St. Gothard Tunnel below, except that there are three phyllites with calc schists, &c., intervening. [He gives no reason for calling these "phyllites," beyond "a comparison with typical phyllites" elsewhere. Assuming they are such, it seems that phyllites (false schists) alternate with true schists.] He concludes [without, however, giving any proof] that they are "faulted together," in spite of the statement "that in the field the calc-mica schist might be thought to exhibit a tendency to graduate into the phyllite," yet "crystalline schists," "wide as is his experience, he has never seen in undoubted [mark this, it is the saving clause] sequence or intercalation with true phyllites." II. *The Schists of the Val Piora.*—Here the schists in question occupy a trough between two gneisses. The order in *apparent* succession downwards is: 1. Gneiss; 2. Dark mica schists; 3. Black garnet schists; 4. Staurolite schists; 5. Calc-mica schists; 6. Rauchwacké; 7. Gneiss. Nos. 2—5 he considers truly crystalline, and to have been subjected to pressure; but no pressure definite in direction had anything to do with the production of the garnets. Nos. 2, 3 are probably older than No. 5, because while the latter is cut off by faults, the former cling to the gneiss as traced in the neighbourhood. III. *The Rauchwacké and its relations to the Schists.*—This rock does *not* show a metamorphic structure [though it contains "quartz, pyrite, mica, talc, tourmaline, disthene, rutile, and

zircon"]. Its rapid thickening and thinning "can only be explained," if it underlie the schists [the author speaks here of its "superposition," but this is probably a misprint], "by very peculiar rolling and faulting." In two sections south-east of Lake Ritom calc-mica schist in one, and gneiss in the other, lie between the rauchwacké and the schists, and by Fongio the rauchwacké lies in the valley between two hills of dark schists, and contains fragments of calc-mica schist. These sections are inconsistent with the idea of a simple fold [but he does not say how he explains them more simply on his own interpretation]. In the Val Canaria section, described by Dr. Grubenmann—if we call Black Garnet Schists *A*, Disthene Schist *B*, Calc Mica Schists *C*, and Rauchwacké *R*—the sequence, represented with the same dip, going up, is *R*, *C*, *B*, *A*, *C*, *A*, *C*, *A*, *C*, *R*, *B*, *A*, gneiss. Thus *B*, *A*, lie between *R* and gneiss, as well as in the supposed fold, and the beds on one side do not correspond to the beds of the other [if, however, we eliminate the first *B*, which is more of a mica than a disthene schist, and may be a zone of crushing, the series is strictly symmetrical about the central *A*. The occurrence of the last *B*, *A*, is a difficulty if they are identical with the others; but this is doubtless known to Dr. Grubenmann]. The rauchwacké also contains schist fragments [but not, it seems, of *A*, which is the commonest rock hereabouts; and the part containing them lies *away* from the main mass of schists]. He explains this section by five faults, and says this evidence appears to him decisive. IV. *The Jurassic Rocks containing Fossils and Minerals.*—In the Lukmanier Pass, to the south of the gneiss, occurs a series of sandstones, slates, and spotted rocks, with Jurassic fossils, and in the midst towards the south is a band, with boundaries parallel to the bedding, of a crushed schist or gneiss, "a member of the crystalline series" [so that in fact a metamorphic rock alternates with non-metamorphic ones]. The position of the latter is *accounted for* by faults along the planes of junction. In the Alp Vitgira the southern slope is black garnet schist, higher up is slaty Jurassic rock, with belemnites, to the south again the gneiss. These are all represented as having parallel boundaries, *i.e.*, as though they were conformable, except for the ground being covered at the junctions. In the Nufenen Pass the succession, according to Von Fritsch, whose "map is accurate enough," is 1 gneiss, 2 rauchwacké, 3 granatiferous rock, 4 Jurassic rock, with fossils, 5 granatiferous rock, 6 calc-mica schist. These so-called garnet rocks he shows not to contain true garnets, but some unknown mineral, perhaps couseranite [but he does not explain why this should be looked upon as less a sign of metamorphism, nor account for the pre-

sence of calc-mica schists, and in one of the similar but nodular rocks on the Alp Vitgira he has actually found garnets which he believes to be derivative. The guiding principle in these investigations seem to be the improbability of a less altered rock being in one series with crystalline schists, and the sections are interpreted accordingly].

In the discussion of this paper a very clear exposition of **Dr. Heim's** views is given. He distinguishes between "crystalline schistose" rocks and true "crystalline schists," and all the schists here discussed he places in the former category; but he states that *Palæozoic* rocks "have been converted petrographically into crystalline schists," though "they have not the aspect of true crystalline schists," but "it would be difficult to distinguish them in the hand specimen and without stratigraphical evidence." It is from these and not from the overlying Jurassic schists that the Rauchwacké fragments have been obtained. [This seems to explain the whole matter. The author assures us that *some* of these rocks are crystalline schists. Dr. Heim tells us that, stratigraphically, they may be proved to be Jurassic or Palæozoic, hence the conclusion is reached by him that rocks of these ages may be crystalline schistose.]

720. Irving, A.—"Note on the Airolo Schists Controversy."

Geol. Mag., Dec. 3, vol. vii., p. 252.

This is, for the most part, a general discussion of the differences between Prof. Bonney's and Dr. Grubenmann's views of the section in Val Canaria. He gives eight reasons for accepting the views of the former. These are either borrowed from Prof. Bonney's paper, or are of a general character, so that they do not advance the question. The author points out, in a supplementary note, that the theory he enunciated in 1889 ("Chemical and Physical Studies," Appendix II., Note T), that the apparent intrusion of the Laurentian into the surrounding series was due to a thin crust solidifying [the Keewatin rocks, apparently, are the solidified thin crust!] and sliding over the viscous mass beneath [the Laurentian Gneiss], has now been adopted [!] by **A. C. Lawson** (Bull. Geol. Soc. Am., vol. i., p. 175), who discovered the relations between the two.

721. Geikie, A.—On the Origin and Age of some of the Crystalline Schists of Norway.

Rep. Brit. Ass. for 1889, p. 567.

In the country south and east of Trondhjem, embracing the lower parts of the Örkla and Gula rivers, the rocks which contain fossils are in part slates, sandstones, &c., like the older Palæozoics of Britain. Their order of sequence was not observed, but some contain Upper Silurian, others Lower

Silurian fossils. These rocks, under the influence of earth stresses, are progressively metamorphosed. At their base they are interstratified with, and rest upon, volcanic basic lavas, agglomerates, and tuffs, which become converted into unctuous chloritic schists, the change sometimes taking place in a hand specimen. Above these are sandstones, quartzites, slates, &c., with black carbonaceous and pyritous bands, from some of which graptolites are reported. These become twisted mica schists, in which the darker bands may still be recognised. These Norwegian rocks are similar to the rocks of the central and southern Highlands. They are easily distinguished from Archæan, and he concludes, from stratigraphical evidence [not stated], that they may be of the same age in the two countries.

In the Bergen country he confirms the discovery, by **H. Reusch,** of Upper Silurian fossils in finely puckered mica-schist or phyllite. Thus the regional metamorphism is post-Silurian, as it is in the West of Ireland.

722. Bonney, T. G.—Note on the Effect of Pressure upon Serpentine in the Pennine Alps.

Geol. Mag., Dec. 3, vol. vii., p. 533.

The serpentine referred to is an intrusive mass in the Gorner Grat, inclosing green schist and succeeded by calc-mica schists, &c. This serpentine has been pulled out into slates, which are thin and almost transparent, and sometimes contorted by a second pressure. These slates consist of translucent flakes of serpentinous character, possibly antigorite, with their longer axes along cleavage planes; between them are black curving lines of magnetite. Associated with these is a rock in isolated bosses, which is probably intrusive. It consists chiefly of one mineral, which he does not identify beyond its being a member of the Clintonite group. The bulk analysis by **J. C. Chorley** shows:—

$S_1 O_2$	28·92
$Al_2 O_3$	44·31
$Fe_2 O_3$	10·86
$Fe O$	2·93
$Mg O$	3·98
$Ca O$	trace
$Na_2 O$	2·98
$K_2 O$	0·67
Moisture	5·70
	100·35

It thus resembles an associate of the serpentine at Roscolyn, Anglesey. The adjacent schist is talcose, and he regards it as produced by alteration of the slaty serpentine. These observations do not support the idea that the streaky structure of the Lizard serpentines is due to pressure.

723. Cole, G. A. J.—Some Problems of the Western Alps; Sediments, Schists, and Greenstones.

Proc. London Amateur Scientific Soc., vol. i., p. 34.

Merely states the problems without offering a definite opinion as to their solution. They relate to the origin of Glaucophane schists, of the Pietri verdi among Tertiary rocks, and of the granite-gneiss.

724. Cole, Grenville A. J., and Gregory, J. W.—The Variolitic Rocks of Mont Genèvre.

Q.J.G.S., vol. xlvi., p. 295, pl. xiii.

This commences with a short outline of the previous writings on the variolite of this district, some, in recent years, regarding it as the selvage of a diabase, others of a euphotide. Mont Genèvre is a village at the lower end of the valley of the Durance, on the Franco-Italian frontier. There are three northward-opening valleys: the Gondran, the Chenaillet, and the Gimont. In each of these there is normal gabbro, occasionally eyed, cut by diabase dykes, and faulted against, not passing into, massive diabase. Associated with the gabbro are masses of "pseudo-serpentine" on Le Chenaillet, "formed from segregation masses of diallage," and "true serpentine," "formed from segregation masses" "of olivine." Round the margin of this there is often a "picrite breccia." The dykes occur mostly in the gabbro. They are: 1. Compact olivine diabase, with a variolitic selvage when lying on an ash. 2. Porphyritic, with large saussurite crystals. 3. Coarse-grained ophitic dolerite. The true Variolite is in large masses of grey-green diabase, which weathers into large spheroids. These have vesicles towards their surface, and also varioles, especially large at the north end of Chenaillet. The varioles are closer together towards the centre of the spheroids, and in the interior their place is taken by brush-like groups of plagioclase. The authors regard the varioles as vitreous selvage products, and account for their occurrence in the mass of the rock by "the rolling over of lavas among themselves" [in which case it must be wrong to say they are spheroidally jointed in the usual sense]. Associated with these rocks are brecciated masses, which might be friction breccias, but which are probably volcanic tuffs [agglomerates], in which are found globose masses of diabase with variolite surfaces, probably bombs. The masses of this rock form dyke-like projections on the slope of Le Chenaillet. The gabbro forms the basis on which these rocks are built, but their original connection has been destroyed. The authors discuss the age of these rocks, but can only arrive at the conclusion that they are post-Carboniferous. Owing to the abundance of what was originally glass, they conclude that the lava was very fluid, like that of the volcanoes of Hawaii.

The plate gives figures of associated structures, but none of the variolite itself.

725. Rutley, F.—On Composite Spherulites in Obsidian, from Hot Springs near Little Lake, California.

Q.J.G.S., vol. xlvi., p. 423, pl. xvii.

This obsidian contains large spherulites with fibres, possibly, from *some* extinctions, of orthoclase, irregularly arranged, and sometimes with concentric structure. These, when examined macroscopically, or under the microscope by dark ground illumination, are seen to be made up of, or contain, a number of smaller spherulites, which he terms primitive, and through these the fibres of the larger are continued, as are also the concentric bandings. This, he thinks, indicates that the larger spherulites are of subsequent formation, the primitive ones having formed when the mass was still viscid, and having aggregated together in groups in which a later crystallization has been set up. **Mr. Iddings**, however, has seen these slides, and considers the small spherulites secondary, and largely composed of tridymite (which appears to be present in any case), caused by the contraction on crystallization leaving spaces in which they have formed; but, the author asks, would such cavities be formed, and would the crystals develop equally well in any direction? Moreover, the small spherulites polarize, and there is more isotropic matter in the interstices.

[**726.**] **Derby, O. A.**—On Nepheline Rocks in Brazil, II.: The Tingua Mass.

Paper read to the Geological Society on Dec. 17, but not published in 1890. Abstract sent to Fellows.

[**727**]. **Gregory, J. W.**—The Variolitic Diabase of the Fichtelgebrige.

Paper read to the Geological Society on Dec. 17, but not published in 1890. Abstract sent to Fellows.

[**728.**] **Holland, T. H.**—Notes on Specimens Collected by W. Gowland, Esq., F.C.S., in the Korea.

Paper read to the Geological Society on Nov. 12, but not published in 1890. Abstract sent to Fellows.

[**729.**] **Hyland, J. S.**—On Some Specimens from Wady Halfa, Upper Egypt.

Proc. Roy. Dub. Soc., N.S., vol. vi., pt. viii., p. 438.

This deals with the characters of the materials of the implements found on the surface. Some are of chalcedonized wood, others are corroded, partly by mechanical agency, and partly by solution by carbonate of soda. Some are composed of dark green holo-crystalline rock, consisting of orthoclase?, hornblende, and mica in small quantity. This he calls by the general name Lamprophyre, and by the particular one mica-bearing Vogesite. He concludes by noting that the sand

at Korti is mostly of quartz and a little uneven felspar, derivable from crystalline rocks by mechanical means.

[**730.**] **Semmons, W.**—On Specimens of Triassic Sandstone from the North of Spain.

Paper read to the Manchester Lit. and Phil. Society, but not published in 1890.

ECONOMICS.

[**731.**] **Wilkinson, C. S.**—On the Mineral Resources of New South Wales.

Paper read to the British Association on Sept. 5, but not published in 1890.

732. Bunning, C. L.—Coal Mining at Warora, Central Provinces, East India.

Trans. N. Eng. Inst. Min. and Mech. Eng., vol. xxxviii., pp. 77—169, pl. iv.

The Wardha valley coal-field belongs to the Gondwana system. It is bounded on the west by metamorphic rocks, to the north-east by Deccan traps, and by Vindhyan sandstone to the south-west. The Talchir group is here about 500 ft. thick. Above this comes the Barakar group, not more than 250 ft. thick, with three seams of coal, the two lower ones thick. This is the only coal-bearing group here. Unconformably above these comes the Kampthis group of sandstones, clays, and conglomerates, from 400—500 ft. thick. This is of wide extent on the western side. Above this comes the Kota Maleri group of the Upper Gondwana system—of no consequence here.

The coal-fields in this area are:—1. Bandar, with 38 ft. of coal in three seams, with sandstone roofs, within 302 ft. of the surface over five or six square miles. 2. Warora. Here the coal is covered by alluvium; there are 50 ft. of coal, at 75 ft. downwards, over three square miles. 3. Telwasa, with 68 ft. in three seams, below 61 ft., but it is of no size. 4. Glingers, the first discovered, with 38 ft. at 121 ft. down, now abandoned; about three square miles in area. 4. Junara, of five square miles. 5. Wun, the largest, not now worked, because in the Nizam's dominions. At Pisgaon there were 27 ft. of coal at 77 ft. down, and at Parsora 31 ft. The area is eleven square miles. He gives analyses of two seams:—

Carbon	47·00	47·97
Oxygen	23·69	19·43
Hydrogen, &c... ..	5·60	5·08
Ash	10·36	14·18
Water	12·24	12·09
	98·89	98·75

The coal easily breaks up and crumbles to dust, and spontaneously ignites. Its calorific power is 7·7 lbs. Fire-clay of good quality occurs about No. 2 seam. The inflammability of the small coal, when stacked in the workings, started a fire in 1882 which has not yet been brought under. It is active over 42 acres. The total amount of coal in this field is about 7½ million tons.

733. Galloway, W.—The South African Coal-field.

Proc. South Wales Institute of Engineers, vol. xvii., p. 67.

This coal-field extends from the sources of the Swart Kei to those of the Usutu, and descends, like a huge fringe, some 10—20 miles wide on the east side of the Drakensberg, being cut off by the rapid fall of the land, but spreads out westwards, on the other side of the range, over a breadth of 160 miles, having a total area of 56,000 square miles, at an elevation of 4,000 ft. The following is the succession of rock:—

	ft.
Volcanic Rocks—a rudely columnar diorite capping the summits	
Cave Sandstone—Buff grey	300
Red Beds—Red and purple sandstones and shales ..	1,500
Coal Measures—Coarse grey grits and conglomerates, a few shales and claystones, mostly thin, reddish beds occasional	1,000
Karroo—Fine-grained, soft, white, buff, red, purple, and mottled beds of sandstone and shale	5,000

These are nearly horizontal. The workable seam of coal lies about 300 ft. up. Sections of the seam are given at Indwe, where the whole is 6 ft. 10 (3 ft. 8 coal), with other coals below, 3—9 in. each, not worked. At Doomkopje 8 ft. 11 in. in all, at Umkapusie 6 ft. 4 in., at Carnarvon Farm 4 ft. 4 in., at Fairview 3 ft., at Molteno 3 ft. 10 in.; all are in bands, with shale between. The coal contains from 36 to 44 per cent. of ash. He considers these coals to be drift coals, as **A. H. Green** had said, and not to have formed on the spot, as **H. G. Seeley** supposed.

734. Chance, H. M.—Geology of the Chocktaw Coal-field.

"Colliery Guardian," vol. lx., p. 100.

This is an extension of the Arkansas Coal-field; the thickness of the coal strata is 8,500 ft. He has studied the lie of the country, and in consequence discovered a new coal-field near the Poteau Mountains. He gives a generalised section of the Coal Measures, and mentions a third basin, called the Grady Basin.

735. Valentine, G.—On a Carbonaceous Mineral or Oil Shale from Brazil: its Formation and Composition as a key to the origin of Petroleum.

Proc. S. Wales Inst. of Engineers, vol. xvii., p. 20, plates i., ii.

The mangrove trees are bored by insects, then decay rapidly, and the *débris* is floated and dissolved in the water. In this way is formed on one side of Joas Branca Island, Bahia, a bituminous mineral which they call "tufa." It is very light, porous, waterlogged, and brittle, and grey or green in colour. It contains 61·64 per cent. of volatile matter (gas 57·03, water 4·57, sulphur ·04), and 38·36 per cent. of coke (carbon 7·84, sulphur ·82, ash 29·70). At a low-temperature distillation it yields 65·5 gallons of oil per ton. The other side of the island has only pipes of similar material. The old oil shales may have had a similar origin. The plates show the beds on each side of the island.

[**736.**] **Brindley, W.**—On the Marbles and other Ornamental Rocks of the Mediterranean.

Paper read to the British Association on Sept. 5, but not published in 1890.

737. Elliott, G. F. S.—Notes on the Diamond Mines and Gold-fields of South Africa.

Trans., &c., of Dumfries and Galloway Nat. Hist. and Ant. Soc., No. vi., p. 197.

The diamond mines are distributed along a belt of country 80 miles long by 2—3 miles broad, possibly a line of weakness. The following sections are noted:—

	Kimberley Central. ft.	De Beers No. 1. ft.	De Beers No. 2. ft.
Débris	—	—	—
Red sand	3	3	3
Dolerite	40—50	95	63
Black and other shales	240—250	195	225
Amygdaloid	626	?	395
Ancient rock	Diabase	?	?

The edges of the black shale rise at 45°, proving the dolerite intrusive. He considers the volcanic eruptions must have been subaqueous, and the holes filled with mud from the sea bottom, because: 1. The blue earth is not distinctively igneous. [It is to be presumed that the "amygdaloid" is the blue diamondiferous earth, though it is not so stated.] 2. It does not cause alteration; 3. It contains lignite and limestone shales in it. [All this is consonant with its being a volcanic ash or tuff, as usually supposed.] He considers it of the age of the Kimberley Shales.

Gold-fields.—The gold occurs in three forms: 1. In quartz reefs in rocks of ancient date. 2. In placer mines, the sand going up to the summit of the highest mountain in the neighbourhood. 3. In "bankets" at Witwatersrand—the

name means a Dutch almond-rock, alluding to the conglomerates. The west dip is at 45°, the east dip, three miles off, is at 12°—60°. At Johannesburg the schists, &c., dip at 80° down to 45°. The coal seams are horizontal. [Is, then, the gold in *unconformable* beds below?]

738. Monckton, G. F.—The Auriferous Series of Nova Scotia.

Proc. Geol. Ass., vol. xi., p. 454.

This paper consists of miscellaneous details with regard to Nova Scotian gold mining, The auriferous series consists of quartzite and clay slate, referred to the "Cambrian." There are two main anticlinals, one at Wine Harbour, and the other at Ecum Secum, where are the chief gold-bearing rocks. The lodes "are inter-laminated with the slate beds, which they sometimes cross, but do not cut the quartzite." The beds are thrown into two series of sharp anticlinal folds, the axes of which are W.S.W. and W. At their intersection the lodes outcrop so that they run in an elliptical form. The lodes vary from 18 ins. to 70 ft. The expanding lodes contain rich gold in the expansions, though it is often invisible. The principal lodes occur on the hanging wall, and sometimes in the slates themselves. Stringers of auriferous quartz ramify into the quartzite walls, and the gold is deposited in "paystreaks," which are lenticular, and have a different dip to the lode. There is, in some large anticlinals, a depression at the top, and this is often richer. No gold has been worked in alluvial deposits.

[**739.**] **Halse, E.**—Some "Banket" Deposits of the Gold Coast, West Africa.

Paper read to the N. of Eng. Inst. Min. and Mech. Eng. on Dec. 13, but not published in 1890.

[**740.**] **Galloway, W.**—The South African Gold-field.

Paper read to the S. Wales Institute of Engineers on Nov. 25, but not published in 1890.

741. Dorsey, E. B.—On the Witwatersrand Goldfields.

Rep. Brit. Ass. for 1889, p. 592.

The rocks which form this gold-field are bedded strata of sandstone, quartzite, slate, and conglomerate, arranged in a basin-like form, like the beds of a coal-field, having a southerly dip on the north and a westerly dip on the east. The dip is greater at the edge of the basin than in the centre. Thus, the main reef, which is lowest, has a dip of 25°, but the black reef and Zuur Bult reef above are flat. The gold is principally contained in the beds of conglomerate, in the interstices between the pebbles. These beds are called "banket reefs." They are remarkable for their great uniformity of yield of about ¾ oz. per ton, over a distance of 25 miles long at present, and 200 ft. deep, the only variation

being due to the occasional working of some richer leaders. There are beds of coal in the series and intrusions of diorite.

[**742.**] **Adair, A.**—The Witwatersrand Gold-fields of the Transvaal Republic.

Paper read to the Whitehaven Scientific Association. Reported in local papers.

[**743.**] **Bayldon, D. H.**—The Hauraki Gold Mining District (Northern Section), Auckland, New Zealand.

Paper read to the N. of Eng. Inst. of Min. and Mechanical Engineers on Feb. 8, but not published in 1890.

744. Liddell, J. M.—The Gold-fields of the Valley of De Kaap, Transvaal, South Africa.

Trans. N. Eng. Inst. Min. and Mech. Eng., vol. xxxviii., p. 171, pl. ix., x.

The best gold reefs occur in a range running 50 miles to north-east, 1,000—2,000 ft. above the Kaap Valley, called Makonjwa. They consist of quartzite and slate, dipping 70°—90° to south-east. North-east from Barberton, this swells into Sheba Hill. The quartz rock is bedded, and crops out here. This is crossed by gold lodes. Another bed below is also intersected by rich cross veins. The gold is richest where dykes cross the quartzite.

745. Pattinson, J. and H. S.—On Chilian Manganese Ores.

Rep. Brit. Ass. for 1889, p. 537.

This gives three analyses of ores, 1 from Santiago, 2 and 3 from the vicinity of Coquimbo and Carrizal. The ore is found in stratified beds, varying from a few inches to 6 ft., on the sides of the hills, called the "Cordilleras del la Costa." Their large percentage of protoxide shows them to be of more value for the metal than for the oxygen.

	I.	II.	III.
Manganic oxide	69·23	55·06	66·03
Manganous oxide	11·92	23·05	10·39
Silica	4·17	7·30	4·75
Lime	1·13	2·33	5·36
Sulphuric Acid	0·05	0·13	1·57
Phosphoric acid	0·12	0·14	0·05
Carbonic acid..	—	0·18	2·53
Other ingredients.			

746. Ward, Thos.—The Salt Deposits of the United States of America and Canada, with Notes of a Visit to the Most Important of Them.

Trans. Manchester Geol. Soc., vol. xx., p. 471.

A chatty paper, descriptive of a trip, but with very little geology, and nothing new. He gives as an appendix the heights above sea of the Rock Salt in New York, from information given by F. E. Engelhardt. The thickness varies from 41 to 85 ft.

PERSONAL ITEMS.

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Mineralogical Society,	R. H. Scott, F.R.S.
Geologists' Association,	T. V. Holmes, F.G.S.
Yorkshire Geological and Polytechnical Society,	Marquis of Ripon, K.G., F.R.S.
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British Association, Section C,	A. H. Green, F.R.S.

NEW FELLOW OF THE ROYAL SOCIETY.

Teall, J. J. Harris, - - Petrology.

NEW FELLOWS OF THE GEOLOGICAL SOCIETY.

Elected	
Jan. 8.	Andrews, William, *Coventry.*
	Berkeley, Earl of, *London.*
	Croston, James Wright, *Manchester.*
	Gibson, Walcot, *London.*
	Watkins, Arthur Octavius, *Newport, Mon.*
Jan. 22.	Beard, Edwin Thomas, *Hollesley Bay.*
	Fairley, William, *Edinburgh.*
	Lambe, Laurence Morris, *Ottawa.*
Feb. 5.	Atkinson, Wheatley James, *London.*
	Gooch, A. E., *London.*
	Hobson, Bernard, *Sheffield.*
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